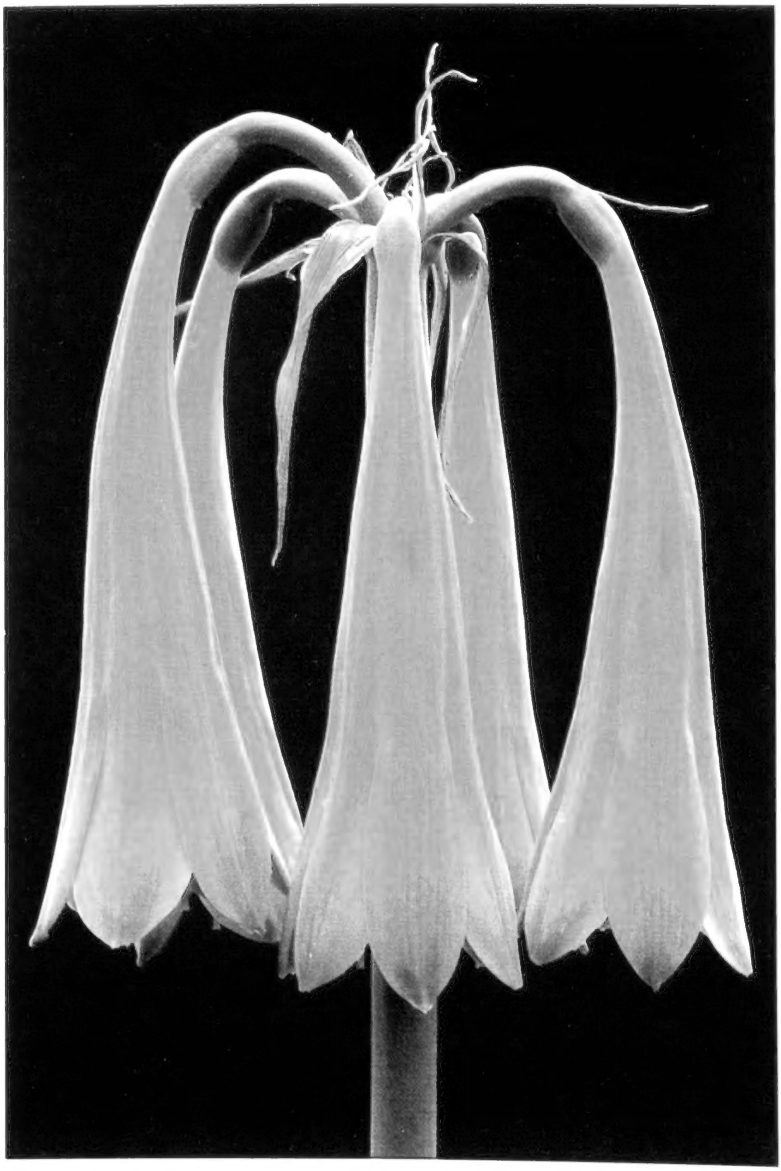
HERBERTIA

VOLUME 52 1997



HERBERTIA™
is the journal of the International Bulb Society and is devoted to the botany and horticulture of all geophytic (bulbous) plants. Special emphases are the taxonomy, culture, varieties, cultivars, history, discovery and conservation of petaloid monocotyledonous and dicotyledonous plants of the Amaryllidaceae, Liliaceae, Iridaceae and all other plant families with geophytic species. Papers on geophytic plants in any plant family are welcome.

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ADDRESS FOR ALL CORRESPONDENCE

International Bulb Society
P.O. Box 92136, Pasadena CA 91109-2136
United States of America

The International Bulb Society is a nonprofit, scientific and educational organization incorporated in California in 1943. Dues and donations to the Society are tax deductible under Section 501 (c)3 of the Internal Revenue Service Code. Dues are U.S. $30.00 per year [July 1 through June 30] for U.S. addresses; yearly dues for addresses outside the U.S.A. are $40.00, payable by checks *drawn on a U.S. bank only*, international money order or U.S. dollars (currency) to the International Bulb Society, mailed only to the address on page one. Journal and newsletters are sent via air mail to addresses outside the United States.

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BEQUEST APPEAL

Donations to the International Bulb Society may be made at any time and are tax deductible as described above.

The Board of Directors makes a special appeal to individuals and organizations who would like to promote the cause of ornamental bulbous plants. The Board asks that your last will and testament include a bequest to the International Bulb Society. There is so much more your Society could do if only the funds were available:

- collecting trips to help save rapidly disappearing plant species;
- scholarships for deserving young botanists and horticulturists;
- more color pictures in future editions of **HERBERTIA**;
- publication of a revised edition of **Amaryllidaceae** and other monographs on bulbous and tuberous plant species.

These are just a few of the plans being made for the society's future. The Board is asking that you become a part of these plans with your tax deductible donation.

Please write a bequest into your will to:

International Bulb Society
P.O. Box 92136, Pasadena CA 91109-2136
United States of America

JOURNAL BACK ISSUES

Some back issues are now out of print. For an up-to-date list of available issues, please request a back issue order sheet, using the Society's mailing address on page one. Available back issues are $10.00 per volume for 1934 to 1991 and $20.00 per volume for 1992 to 1996 (plus $4.00 per issue for additional postage on orders sent to an address outside the United States).

SEED AND BULB EXCHANGE: A SUBSCRIBER SERVICE

Members may participate in the IBS seed and bulb exchange. A moderate charge per packet of seed is used to defray mailing expenses. The next seed and bulb listing will be mailed to all subscribers with the autumn 1997 newsletter, *The Underground*, which is scheduled to be mailed in late September. This is one of the largest bulb seed lists in the world. For more information or to donate seeds or bulbs, please contact:

Charles Gorenstein
IBS Seed & Bulb Exchange Director
PO Box 92136, Pasadena CA 91109-2136
United States of America

A NOTE TO CONTRIBUTING AUTHORS

We welcome your bulb articles and manuscripts for publication. Articles must be received by IBS by January 31 to be considered for inclusion in the following **HERBERTIA** issue. An author of a major article will receive five copies of the **HERBERTIA** issue containing his or her article; additional copies can be supplied at cost if ordered when proof copy is returned. When possible, please send articles in any major word processing format on a 3½ inch floppy disk along with a hard copy.

Please submit copies of artwork, slides, transparencies, graphs, charts and maps. Authors must obtain reproduction permission for all charts, graphs, etc. used which may be copyrighted. Care is taken with manuscripts and illustrations, but we cannot be responsible for their return in original condition. Crisp, clear, black and white photos, color slides, line drawings or other artwork are acceptable. All color slides and artwork used in production will be returned after the issue is printed. Donations towards the cost of color separations are encouraged.

HERBERTIA™
volume 52, 1997

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COVER PHOTO:

Cyrtanthus obliquus is one of the many spectacular species of *Cyrtanthus* discussed in the article beginning on page 153.
Photo by Gunnar Ising.

COMMENTS FROM THE EXECUTIVE DIRECTOR

Charles Hardman

There I was, digging out and tossing away the hundred or so *Nerine bowdenii* bulbs from under the peach tree in my back yard when the thought hit me: Why didn't I do this before, years ago, when there would have been fewer of them? These bulbs were of a *N. bowdenii* variety which produced leaves and new bulbs in abundance. But the flowers were few and far between with no flowers at all from this huge clump of bulbs during some years and two, very rarely three, flowering scapes during the best of years. Into the trash they went and good riddance to them.

The older I get and the more "things" I accumulate in life, the more I recognize that if one of my treasures isn't working for me, it's probably working against me. Those *Nerine* bulbs were given to me by a friend years ago. I tended them, watered them, fertilized them, relocated them, and then tended, watered and fertilized them some more, all of which took time, energy and resources. They rewarded me not with flowers but with leaves and bulbs. I wanted flowers. So out they went.

We gardeners, growers, hybridizers, plant collectors must be efficient nurturers. But we also must be efficient controllers of things that work against us. This is not limited to plants which prove themselves useless, of course, but includes insects, disease organisms, weeds of all kinds and the occasional other sort of pest which shows up in our gardens to do damage. Unpleasant as the subject of intentionally ending any life may be, I mention it here because it is my belief that gardening on any scale is not for the faint of heart. I have watched other gardeners toss snails into neighbors' yards because they couldn't bear to kill them even though the slimy creatures were feasting on the tossers' flowers. I've watched gardeners coax plants along year after year hoping for that bloom or two which might be wheedled out of them on a yearly basis. This is sad and usually oversentimental.

I'm hoping I may encourage some of you to discard such unsuitable plants if you have them and the sooner the better. Do not give them away; you will only be doing someone else a disfavor. Put them in the trash or, if you're sure they're disease free, chop them into bits and mulch or compost them. This will not make you feel bad; rather, the reverse...you will feel good about your decision once the deed is done.

As for the snails that used to ravage my garden, I'm happy to report that they have almost disappeared since a mama opossum and her offspring, along with their subsequent generations, came

to live on my property eight years ago. Skunks also will eat snails, I'm told, as will raccoons, though these last may prove too feisty for most people, especially those with domesticated animals or livestock such as chickens. I've been advised that hedgehogs—not native to the Americas—also will eat snails. Depending on your circumstances, any of the above-named mammals can be welcome additions to your arsenal of garden weaponry as, after a meal of escargots, there's nothing they like better than a dessert of their favorite insects.

The weather during this last year has been disastrous in many parts of the world. The summer of 1996 surely must have been one of our longest and hottest here in Southern California. Then, on October 31, we had an early, drenching rain. Huzzah!, a good, wet winter, we thought. On January 23rd, we had our last soaking rain in my area. February, usually our wettest month, brought us nary a drop. March was the same. Now it's mid-May and the storms continue to slide north of us into Washington, Oregon and northern California, all of which have had a super-abundance of wetness this winter.

Meanwhile, Europe has just suffered through a dreadfully cold winter, the ice on The Netherlands' famed canals freezing for the first time in over a decade. Our American midwest and northeast continues to endure winter's pounding while flooding of apocalyptic proportions is plaguing parts of the American midwest for the third year out of four. Growers in some areas of Chile no longer can grow the produce they grew only a few short years ago as the vines wither and the crops dry up due to, so it's said, the ozone layer's depletion. And Sir Peter Smithers writes me that at Vico Morcote, Switzerland, they have had no rain for two months during which time the rains should have been plentiful.

Is something wrong with the weather throughout he world or is this "normal" and the milder more dependable weather of my childhood the "abnormal"?

In Southern California the 1996-1997 winter/spring growing season revealed a perplexing message for bulb growers. It came in the form of bulbs which never came out of their summer (1996) slumber. While we expect this behavior from some bulbs every year, I don't remember seeing the tendency so widespread over so many genera in years past. From *Cyclamen* to *Lachenalia* to *Eriospermum* I waited, as did other growers, with eager anticipation for plants that never emerged out of their sleeping bulbs.

People who work with plants tend, over time, to become more sensitive to the messages plants send out. This is a defense mechanism built into us humans designed, no doubt, to spare us the pains of repeating past mistakes.

We quickly learn how to read some of these messages. If a plant wilts during hot weather it probably needs water. Extreme wilting usually can be translated as: I'm dying...water me now!

But what are we to make of subtler messages? Such as not coming up and leafing out for a year or two. I don't think this is just sulking. I believe that, somehow, the correct signals simply weren't received from the environment and something that is ordinarily an annual event just didn't happen this year the way it was supposed to happen.

Congratulations to Sir Peter Smithers and Dr. Dierdré Snijman for receiving the Herbert Medal for the year 1997. The honor is richly deserved in both cases. It's a wonderful thing to have two such dedicated people working so hard for the promotion of bulbs via providing cultural and scientific information.

Thanks again to Leonard Doran for donating his magnificent collection of *Hippeastrums* and other amaryllids to the International Bulb Society last year. Len is the 1972 recipient of the Herbert Medal. He certainly deserved the award 25 years ago and the ensuing years have only confirmed the wisdom of those who conferred the honor upon him then.

Len's is still one of the most amazing horticultural minds with which I've ever come in contact. He can discuss the chemistry of plants, the geography of plants, the growth and culture of plants, the roots, leaves, stems, flowers, bulbs and other organs of plants, and, in short, everything you always wanted to know about plants, all with equal facility and with an honest, matter-of-fact "I don't know" thrown into the conversation from time to time when he honestly doesn't know. But, nearly always, he knows where you can research the information you seek if you want to. How often I've heard him say, "There's a paper by (so-and-so), published about (such-and-such a year) that would probably help you...".

Thanks in abundance to my fellow Board members: Charles Gorenstein, our efficient workaholic Seed Exchange Director who has for many years brought the Society's membership an incredible array of bulb seeds, many of them uncommon to rare; Dylan Hannon who recently took over the editorship of the Society's newsletter, ***The Underground***; Elisabeth Lassanyi, another workaholic and our Society's Executive Secretary, special projects coordinator, cross-the-"t"s-and-dot-the-"i"s detailer and Society historian; Alan Meerow who now reviews every article we publish for accuracy of scientific content and who is one of the most elegant wordmasters I've ever had the pleasure of working with; and Michael Vassar whose facility as HERBERTIA editor and whose skill with a computer continue to amaze me along with his skill at keeping the rest of us firmly anchored to Planet Earth when our plans for the Society begin to

run ahead of our budget.

The truth is I frequently find myself in awe of each of my fellow members of this Society's Board of Directors in that they are so willing to do so much for so little reward to themselves. My thanks to each and all of you my friends.

And thanks, also, to each of you, the Society's members. Some of you have been with the Society for many years, others for less time but you all have in common an enthusiasm for bulbs, corms, rhizomes and tubers and the flowers and plants they produce. Our thanks to you for your continued interest in bulbs and for your continued membership in the International Bulb Society; by being members you let the Board know your Society is filling a need.

The International Bulb Society is doing well, growing in membership from year to year. We've begun an advertising campaign to help raise membership. You'll see our ads in **The Garden**, **Pacific Horticulture**, the **Rock Garden Quarterly** and other publications. Of course word of mouth is still the best advertising possible, so please spread the word about us among your gardening friends. Let them know they can send for a free color brochure at this address: International Bulb Society, P O Box 92136, Pasadena CA 91109-2136, U.S.A.

To each and all: Grow seeds, grow bulbs, adopt a species, enjoy life, and don't forget to smell the flowers and have some fun along the way. Good gardening to you.

Corrigenda

RETRACTION OF LAFERRIERE, J. 1996. VALIDATION OF NAMES IN *HYMENOCALLIS* (AMARYLLIDACEAE). HERBERTIA 51:66-67

In an unfortunate set of circumstances, a paper purporting to validate various names in *Hymenocallis* that were previously published in PLANT LIFE (HERBERTIA's previous incarnation) appeared in the 1996 volume. Editor Michael Vassar was under the impression that the paper was reviewed by science editor Dr. Alan Meerow. In fact, for reasons as yet unclear, Dr. Meerow never received a copy of the manuscript. Editor Vassar assumed that a lack of reply from Dr. Meerow was tantamount to approval and printed the article as received. Dr. Meerow and several readers have complained seriously about the validity of Laferriere's article and we wish to explicitly retract this paper on the following grounds:

- Species described by Traub in **Pl. Life** 18 (1962): Laferriere makes the claim that these species of *Hymenocallis* were invalidly published because more than one herbarium specimen is cited as the holotype. If one looks at the original descriptions of these taxa it is quite evident that the holotype is designated by a SINGLE collection number. The appending of the letters a, b and or c on this material was used by Traub merely to designate that the holotype comprised more than one sheet. This was not a necessary inclusion, but it in no way invalidates the holotype designation for those species. The majority of North American and Meso-American *Hymenocallis* species flower when the bulbs are in leaf. Thus, it is difficult to fit a complete specimen on a single sheet, and many specimens of this genus consist of two or more sheets.

- Laferriere is also in error listing some of the aforementioned holotypes as "M.G. Henry s.n."; the specimens were prepared by Traub, not Mrs. Henry, from bulbs that were sent to Traub by Mrs. Henry and which Traub flowered in cultivation.

- Species described by Traub in **Pl. Life** 23 (1967): Traub cites the holotype of *Hymenocallis duvalensis* as G.I. Weber s.n. (without a number), with a single date of collection and provenance. He then places the University of Florida Herbarium (FLAS) accession numbers for these sheets in parentheses. Those numbers are not to be confused with a collector's number (or lack thereof) and merely represent duplicate sheets of the same collection. The same situation is true of the holotype of *H. floridana* subsp. *amplifolia*; that is, Laferriere confuses the FLAS herbarium sheet numbers with the collector's numbers (in this case, also "s.n."). These both represent a single collection. The situation for *H. azteciana* is exactly the same as described for species named in **Pl. Life** 18 (1962). Traub 1031 is the holotype, merely represented by three sheets (Laferriere erroneously lists the specimen as "J. Garcia de Frias s.n.," the indi-

vidual who sent Traub the bulbs which he then flowered in cultivation).

- It would appear from Howard's description of *Hymenocallis maximillianii* (**Pl. Life** 38:41, 1982) that it was Hamilton Traub who made the specimens cited as holotype. Howard's No. 68-220 is apparently a living plant accession number. Again, only a single number (Traub 1249) is listed, though with two sheets (a & b).

- Finally, much the same is true of Ravenna's *Hymenocallis incaica* (**Nordic J. Bot.** 6:463-465), in which two sheets under the same collector's number (Ravenna 2880) are cited by the author. Were this in any way a problem, it is highly unlikely that it would have escaped a refereed botanical journal's editorial scrutiny.

In short, there are absolutely no grounds to declare any of these species as "invalidly published" and the appearance of this article in HERBERTIA 51 was an unfortunate accident that the editor now regrets. We affirm wholeheartedly that all submissions of a scientific nature will be reviewed by Dr. Meerow (with confirmation) and possibly one or two outside reviewers at his discretion.

CORRECTIONS: HERBERTIA 51, 1996

In Maurice Boussard's autobiography two errors appear. Mr. Boussard's wife's maiden name was Suzanne Adnet; Maurice's father's name is Marcel, not Pascal. Our apologies to the Boussard and Adnet families.

Following current rules of botanical nomenclature, the name *Hippeastrum blumenavia* as used on pages 118-121 should have been *Hippeastrum blumenavium*.

THE HERBERT MEDAL

The Herbert Medal is the highest honor the International Bulb Society can bestow upon a person for meritorious achievement in advancing the knowledge of bulbous plants. The medal is named for William Herbert (1778-1847), son of Henry Herbert, Earl of Carnarvon. William Herbert had a prediliction for amaryllids and achieved success in their hybridization. He published his research in several monumental works. His arrangement of the Amaryllidaceae and his contributions as a pioneer geneticist and hybridizer helped set the stage upon which other workers, both amateur and professional, have been able to advance.

The award includes honorary life membership in the Society.

The Herbert Medal may be awarded annually or on special occasions by the Society's Board of Directors. Medalists need not be members of the Society to be considered for the Herbert Medal.

The Herbert Medalists

Mr. Henry P. Nehrling, Florida, 1937
Mr. Theodore L. Mead, Florida, 1937
Mr. Arthington Worsley, England, 1937
Mr. Ernst H. Krelage, Holland, 1938
Mr. Cecil Houdyshel, California, 1938
Maj. Albert Pam, England, 1938
Mr. Pierre S. duPont, Delaware, 1938
Mr. Jan de Graff, Oregon, 1938
Mr. Fred H. Howard, California, 1939
Mr. Sydney Percy-Lancaster, India, 1939
Dr. J. Hutchinson, England, 1939
Mr. Carl Purdy, California, 1939
Dr. A. B. Stout, New York, 1939
Mr. H. W. Pugsley, England, 1940
Mr. W. M. James, California, 1941
Prof. Dr A. Fernandes, Portugal, 1942
Miss. E. Lawrence, North Carolina, 1943
Dr. Henry A. Jones, Maryland, 1944
Mr. R. G. Huey, Kentucky, 1945
Mr. Guy L. Wilson, Northern Ireland, 1946
Mr. R. W. Wheeler, Florida, 1947
Dr. R. A. Dyer, South Africa, 1948
Capt. C. O. Fairbairn, Australia, 1949
Mrs. Mary G. Henry, Pennsylvania, 1950
M. Mulford B. Foster, Florida, 1951
Dr. J. C. Th. Uphof, Florida, 1952
Mr. E. A. Bowles, England, 1953
Mr. Thomas R. Manley, Pennsylvania, 1954
Dr. Robert F. Hoover, California, 1955
Mr. E. O. Orpet, California, 1956
Mrs. Morris W. Clint, Texas, 1957
Mr. Wyndham Hayward, Florida, 1958
Dr. Robert G. Thornburgh, California, 1959
Prof. Ira S. Nelson, Louisiana, 1960

Herbert Medalists continued

Mr. Frederick B. Jones, Texas, 1961
Dr. Floyd F. Smith, Maryland, 1962
Mr. W. D. Morton, Jr, Louisiana, 1963
Mr. S. Y. Caldwell, Tennessee, 1964
Mr. Robert D. Goedert, Florida, 1965
Mr. L. Boshoff-Mostert, South Africa, 1966
Dr. Marton Cardenas Hermosa, Bolivia, 1967
Dr. Robert P. Kahn, Maryland, 1968
Mr. W. Quinn Buck, California, 1969
Dr. Thad M. Howard, Texas, 1970
Dr. C. G. Ruppel, Argentina, 1971
Mr. J. L. Doran, California, 1972
Dr. Cesar Vargas, Peru, 1973
Sr. Pierfelice Ravenna, Chile 1974
Dr. John M. Cage, California, 1975
Mr. Floor Barnhoorn, South Africa, 1976
Mrs. Emma D. Menninger, California, 1977
Dr. W. S. Flory, Jr, North Carolina, 1978
Mr. Harry Blossfeld, Brazil, 1979
Mr. Charles D. Cothran, California, 1980
Mr. W. L. Tjaden, England, 1981
Walter & Hilda Latapie, Louisiana, 1982
Mrs. A. C. Pickard. Texas, 1982
Mrs. Marcia C. Wilson, Texas, 1983
Dr. Hamilton P. Traub, California, 1985
Dr. Thomas W. Whitaker, California, 1988
Mr. Grant E. Mitsch, Oregon, 1988
Mr. L. S. Hannibal, California, 1988
Dr. H. Shuichi Hirao, Japan, 1990
Dr. Kenneth E. Mann, California, 1991
Mr. Brian Mathew, England, 1992
Dr. Maurice Boussard, France, 1996
Sir Peter Smithers, Switzerland, 1997
Dr. Dierdre Snijman, South Africa, 1997

MISSION STATEMENT OF THE INTERNATIONAL BULB SOCIETY

Established in 1933, the International Bulb Society is the only international, non-profit, educational and scientific organization devoted to dissemination of information on the growing, conservation and botany of all geophytic plants (commonly referred to as "bulbs").

The International Bulb Society is singular in that it serves all interests and knowledge levels from novices to professional growers and scientists, and covers bulbs—both species and hybrids—of all climate and habitat types.

Bulbs are uniquely adapted for long-term survival in specialized environments, and they are valuable as sources of food, medicines, perfumes, pesticides and visual beauty. But they also are being destroyed in the wild at alarming rates. It is important to save these plants from extinction so future generations will be able to benefit from their unique qualities and their beauty.

The International Bulb Society aims to:

- disseminate information about bulbs via a variety of media.
- educate and encourage the general public, gardeners, horticulturists, conservationists, scientists and educational and botanic institutions to take an interest in bulbs and to become actively involved in their culture, preservation, advancement and enjoyment.
- encourage and sponsor research on bulbs.
- promote the conservation of bulbs (both in habitat and in cultivation) and preservation of bulb habitats, and facilitate propagation and distribution of bulbs and their seeds to further bulb conservation and enjoyment.
- propagate, maintain and distribute rare bulbs for reintroduction into their native habitats.
- facilitate communication between individuals interested in bulbs.

THE E-MAIL BULB ROBIN

Robert M. Turley

The International Bulb Society is linked to cyberspace via personal computer e-mail. An e-mail Bulb Robin exists for those wanting quicker communications than the traditional "snail mail" robin. No more waiting! You may connect anytime to robin members anywhere in the country or on the other side of the world through the e-mail Bulb Robin. This robin flies not from mail box to mail box but through cyberspace whenever the urge and time is right for you. This modern e-mail robin is a discussion group. We do this by having a prepared mailing list containing the e-mail addresses for all the Robin participants. Any responses we make to the Robin are simply addressed to this distribution list. In this way, we can be in touch with each other on a weekly basis or a daily basis.

Where do you sign up? Listed below are the steps and requirements to join:

1. You will need a personal computer (IBM compatible or Macintosh) equipped with a modem of at least 2400 baud.

2. You will need a computer server. Examples are America On Line® (AOL), CompuServe®, Global Network Navigator® (GNN), or a local internet service provider.

3. You must be a member of the International Bulb Society.

4. Then send a request to join by e-mail to RMTurley@aol.com (Robert M. Turley).

New members will be asked to provide some general information about themselves and their interests for the Robin as a way of introduction. Your name will be added to the e-mail Bulb Robin distribution list and this list will be e-mailed to you with instructions on how to use it. Then the fun begins. You may talk all you want about your favorite bulbs with members who have the same interests as you anywhere in the world. There are a lot of exciting things happening with bulbs and bulb people out there right now. We are all connected by the computer and e-mail right in our own living rooms. We are waiting to hear from you!

1997 HERBERT MEDALIST

SIR PETER SMITHERS

I was born in Yorkshire, England, in 1913. I was brought up by Nanny and Granny during World War I, my parents both being absent on war duty. Nanny was a keen naturalist and I contracted a gardening virus at that early age. It has never left me to this day.

When at school at Harrow I began an index of every plant and packet of seeds I ever acquired, a practice which continues to this day, the numbers now being in the 32,000 range. While at Harrow I fell for lilies in a big way and began growing *Lilium sulphureum*. Fifty years later I visited Burma, recovered bulbs of that lily and began breeding from it, later registering two grexes and one clone and distributing the seed. While at Oxford I became a fellow of the Royal Horticultural Society and am now an Honorary Fellow with the Veitch Memorial Medal in Gold for contributions to Horticulture.

World War II did not entirely interrupt my gardening as might have been expected. At sea in the winter of 1939 I was gravely ill and when recovered was invalided to shore duty, first in France whence I got away two days before the collapse of that country and the armistice with the Germans, then in London on security duty at the time of the parachute landings by German agents, then as Assistant Naval Attache at the British Embassy in Washington in charge of the exchange of Naval intelligence between the Admiralty and the Navy Department. My small garden in Georgetown was a failure: too busy with the war. But then I was appointed acting Naval Attache in Mexico, Central America and Panama, obliged to travel widely monitoring possible submarine shore contacts. It was a gardener's idea of heaven, and I made a small garden in Cuernavaca replete with orchid species, palms and aroids and also collected palm specimens for the British Museum Herbarium. But, more importantly, in Mexico in 1943, I collected a wife, Dojean Sayman, of St. Louis, Missouri, who has put up with my gardening habits and other failings ever since.

Back in England after the war, and a Member of Parliament, I took over the garden of my late father at Itchen Stoke, and then moved to that of my late mother in Winchester, Colebrook House, next to the Cathedral, where I made a garden based upon the three medieval streams which ran through it. Orchid growing continued in a greenhouse built off the dining room.

For a time I was a member of Parliament for Winchester and Under-Secretary of State in the Foreign Office. I later resigned from Parliament and the Government when elected Secretary-General of the Council of Europe in Strasbourg. There I made a garden in the Official Residence, working for the first time in a continental climate.

On retirement from Strasbourg my wife and I built a house and made a garden at Vico Morcote, Switzerland, above Lake Lugano, in one of the best gardening climates in Europe, where an extremely wide range of plants can be grown successfully. Here the specialties were magnolias, of which I registered the hybrid 'William Watson', tree peonies, of which I registered a number of hybrids bred from *Paeonia rockii,* and the lily hybrids mentioned previously. The garden was stuffed full of bulbous plants of every kind including hybrids of *Amaryllis belladonna.* In the greenhouse I continued an ambitious breeding program in *Nerine sarniensis,* which ended in 1995 when the program was sold to Exbury, from which famous garden so many of my parent plants originated, and where it is being continued with enthusiasm by Nicholas de Rothschild.

Though the garden at Vico Morcote contained many specialist collections, it was conceived as an ecosystem of exotic plants in which the plants themselves would do most of the work. The work load would diminish as the owners grew old. This, in fact, worked out successfully and the garden is now easily maintained with the help of a part time gardener twice a week in season and once a week in winter.

Out of the garden at Vico Morcote there grew a photographic activity, based on the plants growing in the garden. This won eight Gold Medals for Photography from the Royal Horticultural Society and resulted in 23 one-man shows of photography, mostly in the United States, including one at the National Academy of Sciences in Washington, D.C. Writing in **Country Life**, the President of the Royal Horticultural Society, Sir Simon Horby, wrote: "Sir Peter may have some equals round the world as a gardener, but probably none as a plant photographer".

I regard gardening and plants as the other half of life, a counterpoise to the rough-and-tumble of politics. When the telephone at Colebook House rang with Downing Street on the other end asking whether I would agree to join the MacMillan Government as a Minister in the Foreign Office, I was busy pruning my standard roses. But I accepted with delight! When my constituents would visit me in the garden at Colebrook House at the weekend to present their problems, I was likely to say "All right, tell me about it while I plant these tulips: I must get them in before it rains". This was well understood in a country constituency and tended to gain votes rather than lose them. Also it was good for the tulips. So life was a harmonious whole of two contrasting halves. Now, at age 83, I work less in the garden and much less in politics, but thanks to the imaginative initiative of the International Bulb Society in setting up the "bulb robin", I am gardening on the Internet and greatly enjoying it.

Photo: Lady Dojean Smithers

Sir Peter Smithers

Photo: Colin Paterson-Jones

Dr. Dierdré Snijman

1997 HERBERT MEDALIST

DIERDRÉ ANNE SNIJMAN

During my studies on the family Amaryllidaceae I have come to admire the work of the Rev. William Herbert which revealed his great insight into the characters and relationships of this family despite his not having seen the species in their native habitats. I feel deeply honoured to have been awarded the Herbert Medal by the International Bulb Society and to be associated with his name.

I was born on 27 June 1949, in a small town east of Johannesburg on the South African Highveld. My name, Dierdré, was soon abbreviated to Dee to circumvent the difficulties of pronouncing and spelling it in full. At an early age I developed a great fascination for flowers. Initially these were the ornamentals in my parents' garden but later my interest extended to the wild flowers of South Africa because I saw their illustrations by Cythna Letty and Aruiol Batten, the first botanical artists whose work was easily accessible to me.

I was educated for most of my school life at the Blessed Imelda Convent in Brakpan where my major preoccupation as a teenager was competitive swimming, an interest which has dwindled since to the occasional summer dip in mountain pools while botanising.

After I obtained the South African Matriculation Certificate at Damelin College in Johannesburg I studied for my primary degree in science at the University of Natal's Pietermaritzburg campus. Because of my interest in the natural world I majored in Botany (and also Mathematics which didn't prove to be an abiding interest). During my practical classes I remember being particularly impressed by the flowering heads of *Scadoxus*, my first contact with the Haemantheae. I obtained a Masters degree here in 1973 and at the same time completed an education diploma (a misguided effort, as a year of teaching unruly children was to prove).

I joined the staff of the Compton Herbarium at the world famous Kirstenbosch Botanic Garden in 1974. Here I was fortunate to come into contact and work with some of the now legendary names in South African botany. Prof. R.H. Compton, even at the age of ninety, had just completed his floristic studies and still communicated his enthusiasm for systematics. Although already retired, Miss W.F. Barker provided me with an excellent example in the collection and curation of petaloid monocots. She had built up a substantial *Haemanthus* collection and I grasped the opportunity to embark on a revision of the genus. Dr. Peter Goldblatt and Dr. John Rourke were pivotal, providing me with gentle guidance in my work.

Plant systematics at the Compton Herbarium was practical and theoretical, and a major effort was made, and still is made, to study plant populations in their natural habitat. As a result, field

trips became *de rigeur* and it was while collecting in the field with these experienced botanists that I came to appreciate fully the extraordinary diversity and grandeur of the southern African flora. Field expeditions took me to all parts of the southern African winter-rainfall area, often in the company of Pauline Perry who was revising *Bulbinella* (Hyacinthaceae) and *Eriospermum* (Eriospermaceae). A colleague later confirmed that the appearance of two unaccompanied women in the remote parts of Namaqualand had proved to be quite a novelty and that several years later the visit by the two "botanical ladies" from the Cape could still be remembered.

In all my travels the area which continues to be of special interest to me is Nieuwoudtville on the Bokkeveld escarpment. Here elements of the Succulent Karoo and Fynbos meet to form a mosaic of vegetation types with an exceptionally rich bulbous flora. My small contribution to the botanical exploration of the Nieuwoudtville region is commemorated in the name of a small, parsley-like plant with medicinal properties, *Chamarea snijmaniae* (Apiaceae).

The Genus *Haemanthus* was published in 1984. I was lucky in having one of South Africa's outstanding botanical artists, Ellaphie Ward-Hilhorst, to produce the colour illustrations for this revision —an association which I prized until her tragic death in 1994 and which strengthened my interest in botanical art in general.

A study of the little-known genera *Hessea* and *Strumaria* followed. This work formed part of a Ph.D. degree under the demanding but expert supervision of Prof. Peter Linder at the University of Cape Town. This introduced me to cladistics, now a familiar and indispensable tool, but at first a daunting intellectual challenge. It also focused my attention on the importance of phenology and reproductive biology in support of systematics.

Although I am now studying *Spiloxene* and *Empodium* in Hypoxidaceae, my interest in the Amaryllidaceae is still active. I am particularly intrigued by the pollination biology of *Cyrtanthus*, a genus with great horticultural interest which I would like to understand more fully.

On the 5th of February 1988 I was married to Colin Paterson-Jones, an organic chemist whose hobby was photographing South Africa's Proteaceae, and who shortly thereafter abandoned chemistry research to become a full-time nature photographer and writer. We live with two cats in Newlands, Cape Town, literally surrounded by the riches of this region's unique flora. Most of our leisure time is spent in the veld enjoying its natural treasures.

BRUNSVIGIA NATALENSIS

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The genus *Brunsvigia* commemorates the enlightened German prince Carl Wilhelm Ferdinand, Duke of Brunswick-Lüneburg (1713-1780). *Brunsvigia natalensis* Baker, a beautiful member of the Amaryllidaceae, is described and depicted with cultivation details. The plant was grown from seeds collected in Natal on the top of Mt. Karkloof in January 1987 by James Compton, John d'Arcy and Martyn Rix, gentlemen collectors almost from a previous era with their impeccable manners, honesty and self sufficiency. Two leading botanists and an archivist—who else could be better suited to find interesting and useful botanical specimens?

The seeds were given to me upon the collectors' return to the U.K. On arrival they were found to be germinating and therefore were sown immediately on the surface of a free-draining compost, whereupon they put down a radicle, sent up a leaf and soon developed a small bulb, then very soon became dormant. In May 1989 they were potted singly. By April 1990 some 12 bulbs were large enough to be planted out in the border of a single-skin unheated polythene structure into neutral soil with added leafmould, peat and sharp sand.

Two bulbs flowered in mid-June 1995. In 1996 six flowered at the end of August to mid-September. Their flowers were quite spectacular. My description as a gardener follows: Bulb large, neck just above the soil level, roots thick, persisting when the bulbs are dormant. Leaves 11, 55cm long, 9cm wide, slightly falcate, some with margins undulating, olive green, slightly glaucous on both surfaces, distichous, remaining green for six weeks after seeding. The scape is 75cm high; umbel with 25-37 flowers held on pedicels 28cm long, each flower 5-6cm wide, blood red in colour, no scent detected, receptive on the third day and remaining in good condition for 6-9 days. Overall width of inflorescence: 60cm. Seed capsules are three-locular with each locule potentially able to produce a double rank of three seeds which rapidly develop with some pedicels dropping below the horizontal. By the end of September dehiscence nears completion with the inflorescence withered and detached. Capsules split showing green pea-sized seeds. The flowers were much visited by bumble bees and pollen also was transferred by brush, which ensured every flower produced some seeds. It is understood that in nature the detached inflorescence would be wind blown to help ensure a good seed dispersal.

The bulbs have suffered -8°C [18°F] of air frost without harm

and have for the last two years been fed through the foliage with 10N:10P:10K plus trace elements on a regular basis which has reduced the growing medium from pH 7.0 to pH 6.8.

Over the years six or seven other species of *Brunsvigia* have been raised from seeds and persevered for ten or more growth cycles without any flowering. Consequently they were given to gardeners in Spain and southern France where they soon obliged. It would seem that *Brunsvigia natalensis*, from its quite cold habitat where frost can occur on any night of the year, is admirably suited to a cooler climate, whereas the Cape species require more heat and light perhaps.

At the time of writing (early November), by way of a postscript observation, seeds held in storage both at room temperature and at 5°C [41°F] since September all are devoid of any signs of sprouting. Therefore it is quite possible that the rapid germination of the original collected seeds is connected with the complete reversal of seasons on their receipt into the U.K. from the Southern Hemisphere.

Seeds have been sent to the director of the International Bulb Society Seed Exchange. However, no doubt due to their succulent nature they must be exceedingly difficult to distribute. They average 33 seeds per gram.

Brunsvigia natalensis in flower

A single flower

Photos: Harry Hay

The fruit (seed capsule) of *Brunsvigia natalensis*.

MAGNIFICENT *DAUBENYA*—THE SCARLET LILY OF SOUTH AFRICA'S WESTERN KAROO

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The Roggeveld Plateau, which lies above the Great Escarpment, from near Sutherland to just south of Calvinia, in the winter rainfall Karoo of South Africa, harbours one of the richest bulb floras anywhere. The Liliaceae, Iridaceae and Oxalidaceae predominate, while the Amaryllidaceae that are so varied in the remainder of the South West of the South African Subcontinent are virtually absent.

The climate of this region is particularly harsh. On clear winter nights the temperature frequently falls below -10°C [14°F] and the ground, rendered wet by the winter rains, freezes overnight to depths of 10-15cm [5-6 in], only to thaw again during the day in the warm sunshine. Annual rainfall amounts to 200-300mm [8-12 in] and falls principally during the cool season, June to September. Summers are generally dry, with occasional thunderstorms and temperatures of 30-35°C [86-95°F] are be no means uncommon. The land is then parched and one would never suspect the wonderful flora which it hides.

As might be expected, such environmental conditions have given rise to specialised forms, particularly where the geophytic flora is concerned and endemism is relatively high. Species which belong to different genera have thus evolved similar habits. Among many noteworthy examples we would mention *Androcymbium pulchrum, Massonia* (*Neobakeria*) *angustifolia* and *Daubenya aurea*, all three of which have relatively small, rather deeply buried bulbs and two opposite, egg-shaped leaves that lie flat on the ground. Of these species, the first two are widespread in the Roggeveld, and *Massonia angustifolia* also extends to various places between here and the West Coast under much less rigorous conditions.

By contrast, *Daubenya aurea* is a narrow endemic, confined to only a few patches of rather flat, stony, heavy and sticky brick-red clay derived from diabase (dolerite) rock outcrops. But while dolerite is widespread throughout the Roggeveld, *D. aurea* is confined to a very small area, where it grows in isolated but dense populations of which we know only four.

The three species with flat, prostrate leaves begin their growth after the first substantial rains, usually in June. Within a month or so the leaves are fully developed, and those of *Daubenya aurea* and *Massonia angustifolia* are almost identical so that one cannot

tell which of the two one is looking at when they are not in flower. Their respective populations grow in adjacent patches in the same heavy soil but, in our experience, they never mix and one can get a pure group of several thousand individuals of the one immediately bordering on an even larger host of the other. On the whole, however, the *Massonia* outnumbers *Daubenya* by ten or more to one.

Daubenya aurea usually flowers the last two weeks of September, almost a month later than its neighbour, the seeds of which are often shed before the end of the rains and thus can germinate at once, in soil disturbed by grazing animals. By the time the seeds of *Daubenya* are ripe, summer conditions have set in and germination will, perforce, have to await the next cool season. In both of these plants, seed can be released immediately as the capsules open but they also are dispersed when the dry inflorescences become detached and are blown about the countryside by the summer winds, like miniature tumble weeds. This makes it the more surprising that *Daubenya* is not more widespread.

Daubenya occurs in two colour forms, one yellow, the other the brightest and most luminous of reds. The name of the species, *aurea*—golden, was obviously based on the former which, curiously enough, is by far the rarer of the two and is found in less heavy and more yellowish soil than its scarlet counterpart. The latter has been attributed varietal rank under the name *coccinea*, but there does not seem to be good reason for this, as occasional yellow flowered individuals have been noted within the scarlet populations (Hall 1970) and there is no difference whatsoever between the two, other than colour. Plants with orange-red blooms are not uncommon within the scarlet flowered populations.

The flowering structure of *Daubenya* is remarkable and quite unique. The flowering bud first appears as a round button, completely covered by green bracts. The individual flowers then appear, forming concentric rings around the short central axis. They are strongly zygomorphic, an unusual character in the Liliaceae, and dimorphous, which means that there are two distinct types of florets within the flower-head. Indeed, the outermost row bears three large, colourful curved lobes (petals) while the lobes of florets in the inner rows are vestigial and scale-like. The spectacular flower heads can reach a diameter of 15cm [6 in]. The seeds are round, hard and about 1mm across.

It is not known when or by whom *Daubenya* was first collected nor when it was first brought into cultivation in Europe, but it was first described by Lindley in 1835. It seems, however, to have already been known previously since its author mentions the name *Massonia lutea* Hort. as a synonym. Indeed, *Daubenya* is closely related to *Massonia*, from which it seems to differ only in the dimorphism of

its florets and the irregular perianth. The scarlet flowered form was described later, as *D. coccinea*, which was reduced by Marloth (1920) to a variety. As already stated, the two colour forms do not merit even varietal separation. In 1968 the well-known botanist and horticulturist Harry Hall and his wife Lisabel went to the Roggeveld in search of *Daubenya* and published an interesting and informative account of their experiences (Hall 1970).

The present authors have studied the plant under review for the past 24 years, paying numerous visits to the Roggeveld, both in the icy winter conditions and in spring and summer. Over the years the populations have shrunk alarmingly, both in number and in size due, on the one hand, to more and more of the red clay areas being ploughed for wheat fields and also due to grazing pressure. Contrary to Hall's views, none of the *Daubenya* localities known to us is stony or rocky enough to render it unusable for agricultural purposes. The future of this species is, consequently, far from secure. It would, no doubt, be desirable to try and keep grazing stock away from these plants during the short time when flowers develop and seed is set.

In the winter and spring of 1996, the Roggeveld experienced unusually copious and well distributed rainfall which resulted in a spectacular flowering season, peaking in the second half of September. The accompanying photographs can scarcely convey the splendour of the fields of scarlet *Daubenya,* besides which there were acres of a large flowered magenta coloured *Romulea*, entire hillsides covered with the golden candles of a *Bulbinella*, a large flowered form of *Moraea ciliata*, several species of *Oxalis*, millions of a tall, salmon flowered *Homeria* and dozens of other interesting bulbous plant species.

Both colour forms of *Daubenya* make spectacular pot plants and should be grown in ordinary potting soil to which a small quantity of slow release fertiliser, such as bone meal, should be added. No attempt should be made to grow these bulbs in heavy clay soil, as John Lavranos found out when he planted some in their own native red clay, laboriously collected in their habitat. Despite copious watering during winter, the bulbs failed to show any sign of life for three consecutive seasons. When, finally, the pot clay was broken up, it was found that the bulbs were still alive and well. They were transplanted into an ordinary soil mix and prospered and flowered for many years. The bulbs should be planted at least 5cm below the surface and watered well throughout the winter growing period until after they have flowered in early spring, when water should be withheld gradually. They should be kept entirely dry during the 5-7 warmer months and either left undisturbed in their pots or lifted for inspection and cleaned if

necessary. During the growing season they should be given as much direct sunlight as possible. As already suggested, *Daubenya* comes from an area where, in winter, severe night frosts are the rule. Nevertheless, daytime temperatures are always above freezing. Therefore, in areas that experience severe night frosts followed by sunny frost-free days, pots of this glorious plant can be safely kept in the open.

Horticultural selection work on *Daubenya* seems highly desirable in view of the existence of interesting yellow and orange strains and the fact that bi-coloured, red-and-yellow flowered plants have been reported in cultivation.

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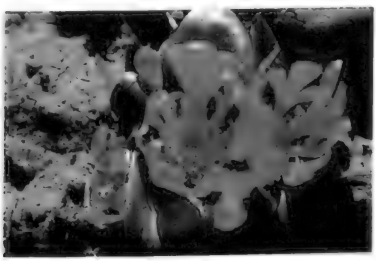

The scarlet form of *Daubenya aurea.*

A colony of the scarlet form of *Daubenya aurea* is spectacular when in full flower on the Roggeveld Plateau. Photos: John Lavranos

ZEPHYRA ELEGANS D. DON AS A CUT FLOWER

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Zephyra elegans D. Don is a monotypic geophyte in the Tecophilaceae (Mathew, 1973; Bryan, 1989). It is found in consolidated sands of coastal regions of northern Chile where it is exposed to prevailing misty west winds which supply most of its moisture (Mathew, 1987; Bryan, 1989; Hoffmann, 1989). Results of soil analyses of samples collected from the natural habitat of *Zephyra* are outlined in Table 1.

Zephyra has a tunicated corm (Fig. 1). Its fibrous coated corm of about 15 mm diameter produces a single branched stem 40–60cm high with many long-lived 2cm diameter florets which are white inside and pale blue on the outside (Fig. 2). During the growing season the original corm dies after usually producing one daughter corm. In Japan, *Zephyra* corms planted in the greenhouse during the autumn flower between the end of February and the end of March (Kim *et al.* 1996a, b).

Zephyra has excellent, commercial, ornamental plant potential with its beautiful flowers, attractive scent and long vase life of about ten days, but there is little cultural information about this crop. The authors have studied the growth and flowering of *Zephyra*.

The growth and flowering habit of *Zephyra* are dictated by the climate of its habitat. The habitat has a very dry summer. After a short, moist, mild winter there follows a long period of 7–10 months without rain. *Zephyra* emerges and grows through the winter and flowers and fruits in the spring. The corms are released from dormancy at the end of the hot, dry summer. As a result, the *Zephyra* has a basic hot–cool–hot annual thermoperiodic cycle.

Zephyra is semi-hardy and grows easily under protected conditions. Growth periodicity and corm dormancy were investigated under these conditions in Japan by Kim *et al.* (1996a, b). Corms of *Zephyra* that were lifted in May, stored at 25°C and replanted at monthly intervals, emerged from November onward. Corms were dormant when lifted in May; dormancy was broken by warm temperatures in storage (25°C for 22 weeks) or in the greenhouse after planting. This warm period requirement to break dormancy also occurs with certain other autumn planted bulbs, such as freesias (Imanishi, 1993).

After a hot summer *Zephyra* sprouts in autumn and flowers soon after the middle of February. A similar life cycle has been reported for *Leucocoryne coquimbensis*, a bulb also indigenous to Chile (Ohkawa *et al.*, 1996). The dormancy of *Zephyra* corms was

broken by storage at 25°C or 30°C for 22 weeks. However, following storage at 30°C, flowering was delayed and the proportion of corms which flowered was less than with storage at 25°C. Corm storage investigations found that storing corms at 25°C for more than five months is necessary to break dormancy. Planting after October, when air temperatures decrease, results in flowering between February and June. Plants should be maintained from 10–15°C at night and below 25°C during the day. Temperatures greater than 30°C adversely affect shoot elongation and rooting so that poor growth occurs with *Zephyra* in summer in warm regions.

With successional planting it was possible to bring *Zephyra* into flower from February to June (Fig, 3 and Table 2). Corms planted between October and January from those stored for 5 to 8 months produced shoots and flowers most rapidly and also had the highest rates of flowering. Other storage periods (for 9 to 11 months) and planting times (February to April) are, therefore, not as commercially profitable.

Although more than five months are required to break dormancy completely in *Zephyra*, 60–70 % of the corms emerged in November following 1–4 months storage, and flowered in February. High ambient temperatures occur in July–August and these corms probably received part of their requirement for high temperatures after being planted.

A few corms stored for 11 months (planted in April) emerged, but quickly wilted because of the high ambient temperatures. Most of the corms stored for 11 months and all the corms stored for more than 12 months (planted after May) did not emerge until November. Emergence of shoots from non-dormant corms seems to be inhibited by high temperatures after planting.

When shoots were approximately 3mm, all the corms rooted, and when shoots were approximately 8mm, all the corms initiated flower buds. When shoots were more than 10mm, corms began to produce daughter corms, and at about 100mm androecium formation commenced. When the shoots were about 200mm, anther and ovule formation started and flowering occurred in March when the flowering stem was about 50cm in length.

Moist storage for two weeks at 15–25°C after dormancy had been broken, accelerated shoot elongation, rooting and flowering. These conditions mimic those in nature where *Zephyra* must sprout quickly after a short, moist, mild winter to thrive a long dry period of 7-10 months. Further, the optimum temperature range of 15–25°C found in this work is similar to the average temperature range in its habitat. With these results and habitat observations in mind it may be possible to find a method of forcing *Zephyra* similar to the precooling treatment De Hertogh (1989) used for forcing freesias for flowering potted plants.

The effects of corm weight on growth and flowering of *Zephyra* was studied by Kim *et al.* (1996c). Non-flowering corms (< 0.3g) only produced a few leaves. In contrast, flowering corms (> 0.3g) produced a few leaves on a stem bearing the terminal flower. Larger corms (> 0.8g) are required to produce flowering stems of commercial quality, although flowering could occur in smaller corms (0.3-0.7g). Small corms of 0.3g size produce corms of a size suitable for cut flower production after one growing season, whereas < 0.3g corms require two growing seasons. Plants produced from smaller corms are vegetative; however, with an early planting, favorable growing conditions, and low planting density, it might be possible for smaller corms to flower in the first growing season. Further studies on other factors that influence the capacity of corms to flower are required to assist the development of this plant as a commercial crop.

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Table 1. Soil characteristics of the natural habitat of *Zephyra* in Carriza Bajo and Huasco, Chile (Kim *et al.*, 1996b).

	pH	EC (1:5)	CEC	Truog P_2O_5	Exchangeable (mg/100g)		
	(H_2O)	mS/cm	me/100g	(mg/100g)	K_2O	CaO	MgO
Carrizal Bajo	8.70	0.119	1.80	37.3	12.1	681	17.6
Huasco	8.03	0.116	4.10	79.2	27.3	172	24.5

Photo: Kimitoshi Sakaguchi

Figure 1. *Zephyra elegans* corm at planting time with tunic partially removed.

Photo: David Brundell

Figure 2. *Zephyra elegans* in habitat in northern Chile.

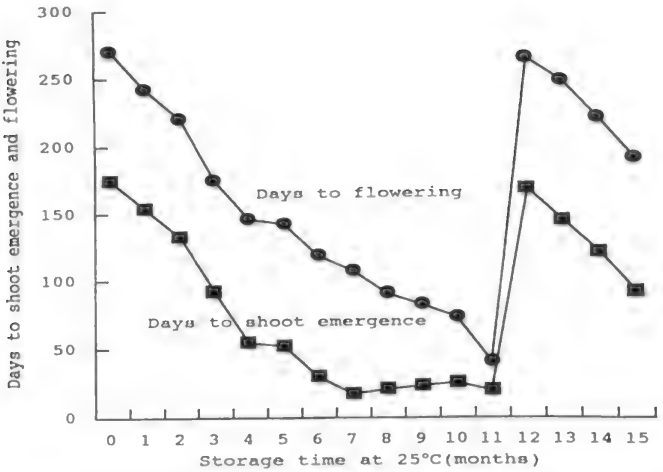

Figure 3. Effects of storage time at 25°C on days to shoot emergence and flowering (Kim *et al.*, 1996a)

Table 2. Effects of storage duration at 25°C on emergence and flowering of *Zephyra elegans* (Kim et al., 1996a)

Storage duration (months)	Planting month	Shoot emergence		Flowering[a]	
		%	Date (s.d.)	%	Date (s.d.)
9	5	25.0	11/15 (7.0)	25.0	2/18 (0.0)
1	6	75.0	11/22 (11.0)	75.0	2/18 (14.3)
2	7	62.5	11/28 (7.5)	62.5	2/24 (7.9)
3	8	62.5	11/16 (19.3)	50.0	2/ 4 (23.0)
4	9	62.5	11/ 7 (13.2)	62.5	2/ 6 (19.7)
5	10	87.5	11/22 (17.4)	75.0	2/18 (14.4)
6	11	87.5	12/ 9 (8.9)	87.5	3/ 7 (7.9)
7	12	100	12/24 (4.4)	100	3/23 (7.7)
8	1	100	2/13 (2.9)	87.5	4/24 (2.7)
9	2	87.5	3/19 (11.7)	62.5	5/17 (4.8)
10	3	87.5	4/18 (8.6)	62.5	6/ 5 (3.0)
11	4	87.5	5/14 (8.6)	12.5	6/ 4 (0.0)
12	5	25.0	11/15 (12.5)	12.5	2/18 (0.0)
13	6	75.0	11/20 (16.6)	75.0	3/ 3 (14.1)
14	7	50.0	11/27 (9.7)	50.0	3/ 6 (5.4)
15	8	75.0	12/ 1 (16.8)	37.5	3/ 9 (9.9)

a: Flowering of the first floret

ARTIFICIAL ALLOTETRAPLOIDS IN *CYRTANTHUS*

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CYRTANTHUS BRACHYSCYPHUS x *C. MACKENII*

The first allotetraploid flowered in 1955 (Fig. 1, Ising 1997, Ising 1962). It was produced by colchicine treatment of germinating seeds in 1952. The seeds came from a cross between *Cyrtanthus brachyscyphus* and *C. mackenii* (at that time called *C. parviflorus* and *C. lutescens*). As only one seedling survived out of 155 treated, the concentration of the solution as well as the duration of the treatment apparently was too trying for the seeds. Some other methods, such as injection of 5cc 0.1% colchicine solution in the bulb just above the basal plate, have later been tested and found to be more efficient.

When the first plant flowered there were two flower stalks, one from the main bulb and another from a lateral bulb. The flowers of the stalk from the lateral bulb were bigger and had a darker red colour than those of the primary stalk, This lateral plant turned out to be a tetraploid with 32 chromosomes compared to the normal diploid number ($2n$=16) of the main bulb. The progeny of this tetraploid plant, after selfing and in crosses to the diploid *C. mackenii*, later constituted the main material for a thesis together with an analysis of the chromosomes of over twenty species of *Cyrtanthus* collected in South Africa during a three month stay from November 1962 to February 1963 (Ising, 1970).

The species *C. brachyscyphus* and *C. mackenii* have eight pairs of very similar chromosomes. The main difference was observed for one of the smallest chromosomes (G) that in *C. mackenii* is longer and with a so-called secondary constriction near one end. As the centromeric constriction is at about the same distance from the other end of the chromosome, it had the appearance of a chipolata sausage. When studying the first meiotic division of the diploid hybrid, a bridge and a fragment were observed in some cells. This indicated a so-called paracentric inversion (a sector with reversed gene order) in one of the longest chromosomes. Without a meiotic study this cryptic structural difference had been overlooked. These two structural differences between the two species probably caused the reduction in pollen fertility (80% compared to about 98% for each of the parents).

The tetraploid plant was pollinated with pollen from diploids and the chromosome constitution was studied for 327 triploid

progeny plants. As the chromosomes could be grouped into five different morphologically distinct groups, each made up of one (A and H) or two chromosomes (B+C, D+E and F+G), it was possible to count the frequency of each type in all these triploids. In the tetraploid meiosis there will occur quadrivalents (associations of four chromosomes). A 3:1 segregation of the chromosomes in such quadrivalents will result in a gain or loss of chromosomes in the progeny. As three plants had unidentifiable morphologically new chromosome types, the study was limited to 324 plants. For these there was a total gain of 72 chromosomes and a total loss of 148 chromosomes. The gain of 72 chromosomes corresponds to an equal number of lost chromosomes from a 3:1 distribution of quadrivalents in anaphase I. Therefore, the number of quadrivalents would be 2 x 72=144 of the possible 2592 (324 x 8=2592) quadrivalents, *i.e.*., 5.6%. The remaining loss of chromosomes (148-72=76) may be distributed among the eight different chromosomes, which means that for each chromosome A to H there would be a mean loss of 9.5 chromosomes. Ten chromosomes were lost of the smallest type (H) based on the finding of 20 disomic and 10 tetrasomic plants among the triploid progeny plants (20-10=10). This is in correspondence with expectation. For the largest chromosome (A), there were 27 disomic and 6 tetrasomic plants. This means only 2 x 6=12 quadrivalents with a 3:1 segregation out of 324 possible chromosome configurations or 3.7% which is the lowest figure among the chromosome types studied. The reason for this may be a reduced chromosome pairing between chromosomes from the two parents because of structural dissimilarities in chromosome A. Thus, the loss figure for chromosome A is 27-6=21 which is significantly higher than the expected 9.5. If there is a paracentric inversion in one arm, resulting in a bridge and fragment in anaphase I, we would expect an increased loss frequency. Consequently, the conclusion was that chromosome A had the inversion observed in meiosis.

For chromosomes B+C and D+E, there were no deviations from the expected mean in loss frequency (22 found compared with 19 expected for B+C and 18 found compared with 19 expected for D+E.). For chromosomes F+G, however, there were only 5 losses found compared to 19 expected. The reason for this may be that the two chromosomes G in the two species are so different that they usually do not pair in quadrivalents but rather as two bivalents causing no loss of chromosomes. Most likely chromosome F may be responsible for the five losses even if the figure is a little low compared with the expected 9.5 for only one chromosome. Thus, there is a tendency for bivalent pairing for some chromosomes in this tetraploid hybrid even if there still is a high frequency of quadrivalents in meiosis. Therefore, it is not a true allotetraploid but may rather be named an auto-allotetraploid. It segregates in such characters as

flower colour and flower length. Most plants from selfing of this tetraploid are more vigorous than the diploid parents. The seed set is only about half of that of the diploid plants and some of the progeny after selfing will become unbalanced aneuploids with a somewhat reduced viability.

CYRTANTHUS x *HOLFORDII*

This is an allotetraploid hybrid between *Cyrtanthus mackenii* and *C. sanguineus* (alternatively *C. eucallus*). It was produced by colchicine treatment of the diploid seedlings about ten years ago by Frank Holford in Cornwall, England. The size of the flowers makes it possible that *C. eucallus* is involved, but the shape makes it more likely that a small *C. sanguineus* is one parent (fig. 1). A study of the chromosomes will help in solving this problem. As Frank Holford also had some *C. sanguineus* plants under the name of *C. eucallus* it is more likely that the doubtful parent is *C. sanguineus*. One parent, *C. mackenii*, has yellow flowers (also white and pink forms exist), *C. eucallus* has orange-red flowers, while *C. sanguineus* has red flowers (Figs. 1, 3 and 8; Ising 1997). The tetraploid hybrid is almost true-breeding after selfing and is more vigorous than any of the parents. The differences in chromosome morphology between the two crossed species may be explained by a few translocations and/or inversions involving at least five of the eight chromosomes. Further studies will clarify this point. Even if not completely stable from one generation to the next, it will be possible to select more stable lines. It will certainly be of future value in the breeding of tetraploids as one parent in crossings to other allotetraploid hybrids.

Here follows a description of the morphology of this new plant: **Bulb** ovoid, up to 45mm in diameter, with brown tunic and a neck 25-35mm long. **Leaves** 3-5, contemporary with the scape, linear and up to 40cm long, 10-15mm broad and tapering to both ends. **Peduncle** hollow, 30cm long, about 8mm in diameter. **Flowers** 4-8 in an umbel, faintly scented, slightly nodding; perianth 40-50mm long, orange-red. **Tube** about 40mm, trumpet shaped with the base 3mm gradually dilated to the throat, 10-12mm wide. **Lobes** 12mm long and 7mm broad, slightly spreading to 25mm width. **Stamens** biserate; anthers included on short 2mm filaments. **Ovary** with 10-20 flattish ovules; usually less than 10 black seeds. **Style** trilobed at apex into stigmas 2mm long.

This description differs in some characteristics from the description of the diploid sterile hybrid between *C. mackenii* and *C. sanguineus* named *C.* x *henryae* Traub, described in **Plant Life** volume 6, 1950. Flowers of the tetraploid *C.* x *holfordii* are smaller in all parts. Even the leaves and some other parts of the plant are smaller than for *C.* x *henryae*. Below is a table showing the differences.

	C. x ***henryae***	*C.* x ***holfordii***
Leaves: length	38-55cm	40cm
Leaves: width	17mm	10-12mm
Peduncle length	33-40cm	30cm
Peduncle base diam.	12mm	10mm
Spathe-valves length	40-90mm	40mm
Pedicels: length	25-70mm	20mm
Perigone length	60-67mm	40-50mm
Tepaltube length	45mm	30-40mm
Tepalsegs length	20mm	14mm
Tepalsegs width	11-12mm	10mm
Stamens in two rows		
below apex of tube (3):	6mm	6mm
below apex of tube (3):	9mm	11mm
Filaments length	3mm	6mm
Style length	55-60mm	40-45mm

Even if the tetraploid *C.* x *holfordii* is smaller than the diploid *C.* x *henryae* it has the advantage that it is fertile and almost true-breeding from seeds. The pollen fertility is 95-99%, which may mean that there are mainly bivalents in meiosis. It will therefore be useful in crosses to other allotetraploids.

Experiments are underway to treat other hybrids with colchicine in order to produce a substantial number of allotetraploids which may be useful in further hybridization on the tetraploid level.

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CORYDALIS

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Corydalis is one of the more exciting and surprising genera for bulb lovers. Growing from tubers, rhizomes or fibrous perennial roots as many *Corydalis* do—with biennial and annual species thrown in for good measure—and with a large number of species loving cool to cold climates, this genus ought to be more widely experimented with. Others seem to be of like mind for the genus currently is enjoying a boom in popularity.

Just the color range of *Corydalis* flowers is reason enough for bulb enthusiasts to try them. Colors include blues, blues on the gray side, turquoise blues, true blues and pure blues as well as yellows, reds, purples, pinks and multi-colors. Where they grow well they often grow bounteously, so be prepared to share.

Corydalis is usually considered to be a member of the fumitory family (Fumariaceae), although certain authorities prefer to consider the genus a member of the subfamily Fumarioideae of the poppy family (Papaveraceae). The genus contains between 200 to 440 or more species, depending on the authority, and is widespread in the north temperate zone. (Ten new species from China have just been described and that country, still not well known botanically, no doubt contains more new species.)

The name *Corydalis* comes from a Greek word meaning "crested lark". The closest relatives of this genus are *Dicentra* (bleeding hearts), *Rupicapnos* and *Sarcocapnos* from North Africa. There are also *Corydalis* species native to Africa.

About half the members of this delightful genus are tuberous or rhizomatous perennials with fibrous-rooted perennials, biennials and many annuals rounding out the genus. The heights of *Corydalis* species range from two or three inches (high alpine species) to about four feet (woodland species).

If you want to increase your plants there are several methods. Propagation of tuberous species can be made through seeds, which need to be be fresh for they can lose their viability quickly, or by natural division of the tubers as well as by cuttage of the tubers for those more daring souls. The methods for increasing rhizomatous species are similar and equally easy.

Corydalis grow in a variety of locations from cool woodland to dry shade, to full sun to areas that get a summer baking. If growing members of this genus in containers—where they can be appreciated to their fullest—one should make sure the containers are large, for even the small species enjoy plenty of root room.

The jaunty flowers of *Corydalis* have spurs which may be long, short, curved, crested, hooked, or blunt and flowers can point upward, downward or horizontal. Many species have beautiful fern-like foliage, a bonus which complements their beautiful flowers.

While listing the best or most worthwhile members of any group is certainly sticking one's neck out and a practice open to question (Best for what? Most worthwhile where?) in an article titled "Coveting *Corydalis*" Jim MacPhail and Bob Woodward have done just that: they have graciously listed what they call the Top Dozen *Corydalis*. They name *C. cashmeriana* (not tuberous, although certainly one of the best), *C. fumariifolia, C. solida* (red form), *C. wilsonii, C. popovii, C. ledebouriana, C. schanginii, C. bracteata, C. turtschaninovii, C. glaucescens, C. latifolia* and *C. rupestris*. Of these, *C. solida* is notoriously easy to grow and, as it has many variants ranging in color from dusky purple through deep dull purple, pinks, salmon red, smoky blue, creamy white and pure white, this species might be a good one to start with if one plans to build a *Corydalis* collection.

The beauties to be found within this wonderful genus are tempting reasons to endure the rigors of a cold and snowy climate, for it is in areas where the iceman cometh in his yearly rounds that so many *Corydalis* species grow and bloom their best. Especially if you live where the winters are cold do try a few—or even many—members of this fanciful genus.

For those of us who live in warmer climes, growers suggest placing *Corydalis* in the refrigerator for a month or so before planting each year.

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NAMIBIAN FIELD NOTES: 1990

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During the 1989 International Symposium sponsored by the International Bulb Society and the University of California at Irvine Arboretum, one of the guest speakers was Dave Hardy from the National Botanical Institute at Pretoria, South Africa. Dave had befriended me during my prior field trips to South Africa, and I was delighted to see him at the symposium. In our conversations, I indicated that I was planning to collect in Namibia again during the summer of 1990; Dave replied that he would like to accompany me if he could arrange the necessary sponsorship from Kirstenbosch. This casual conversation eventually translated into a bonafide field trip which began on February 20, 1990 and lasted 17 days.

It was a tremendous asset for me to have Dave as a traveling companion as he is thoroughly familiar with the topography and indigenous flora of Namibia. He also had local friends who proved to be of great assistance. Dave's interests during the expedition were primarily succulents and trees; he collected numerous pressed specimens and seeds, many whose botanical names I was not even able to pronounce. While I was pursuing *Crinum*, he was more than occupied with his collections and often worked late into the night changing the drying papers on his pressed specimens.

Following our arrival at the capital, Windhoek, we visited with an old friend of Dave's, Willie Giess, retired curator of the South West African Herbarium (National Herbarium of Namibia). What a fascinating individual! Willie was German and had been interred in a concentration camp in South West Africa (Namibia) during World War II; one of the men in his compound was a botany professor who made Willie his student. After the war, Willie spent nearly 40 years surveying the flora of Namibia; he carefully maintained diaries of all his collections, and he supplemented many specimens with black and white photographs which were numerically arranged in albums corresponding to his collection diaries. His collection numbers exceeded fifteen thousand. While Willie discussed *Aloe* with Dave, Mrs. Giess brought forth the albums so that I could review his *Crinum* photographs. I jealously noted the photographs of *C. nerinoides* (*Ammocharis nerinoides*) from Farm Combumbi and silently hoped that someday I would find this plant. There was also a photograph of a dwarf striped *Codonocrinum* from Farm Renette; was it *Crinum acaule*?

Willie then called me aside to talk. He thought that he had discovered a new species many years ago near the Namib Desert, and

he showed me numerous photographs of a striped *Codonocrinum*. However, he had sent his pressed specimens and photographs to Helmut Roessler, a botanist in Germany, for analysis. Roessler had decided that the bulb was a variety of *C. lugardiae* and had published it as such in his monograph on South West African *Crinum* in 1974. Willie and I discussed his photographs and the numerical measurements recorded in his diaries. It took only a few moments to realize that Willie was correct; the bulb was not *C. lugardaie* for several reasons: 1) the leaves were >60mm wide, far too wide for the Namibian form of *C. lugardiae*; 2) the flowers had no measurable pedicels whereas *C. lugardiae* had a short pedicel 5-20mm long; 3) the fruit bore an apical projection about 60mm long while the fruit of *C. lugardiae* had a short 10-20mm projection; 4) the bud tips were pointed instead of rounded and blunt; and 5) the habitat was desert sand removed from a vlei or stream, in contrast to *C. lugardiae* which prefers sandy clay near a water source. I was surprised when Willie told me that Roessler (as well as Sölch and Verdoorn who also published monographs on Namibian *Crinum*) had never visited Namibia. Willie showed me three farms on a map where he had found the species, but he was uncertain of the actual locations other than that he had observed the plants from the road. ("Farms" in Namibia are huge tracts of land, each encompassing tens of thousands of acres.) I thanked Willie and told him if I could find the bulb and demonstrate convincingly that it was a new species, then I would name it after him. He chuckled.

While in Windhoek, we also visited the herbarium, but unfortunately all the pressed specimens were still in storage pending completion of the new facility. The curator, Mike Müller, was ill with malaria, but he made a concerted effort to meet briefly with us and to offer his services—in particular, we needed a plant permit.

Next morning we decided to search for Giess's *Crinum* and headed west through the mountains of Khomas-Hochland. Dave was soon eying magnificent specimens of *Cyphostemma currori* in the rocky terrain. After several hours of driving on narrow curving mountainous roads we descended into sandy arid bushlands. The aridity became progressive as we continued westward, and by the time we reached the farms indicated by Herr Giess, we were in pre-Namib desert, only a few kilometers from the formal Namib Desert. Some rainfall had occurred in the region about three weeks previously, but now it was conspicuously dry. We drove slowly and scanned about 40km of road frontage bordering the subject farms; vegetation other than low scrubs and bush was sparse. We did not spy any *Crinum*. It was difficult for me to comprehend that *Crinum* even existed in such an environment. We drove briefly into the nearby Namib Desert Park; it was virtually barren. Dave remarked

that he had once collected in the Namib Desert for six weeks, and it had rained every single day; during this once-in-a-lifetime phenomenon, he and his companions were discovering new species of plants daily. How I wished for rain at that moment.

We spent the night at a familiar lodging, the Tsaobis Leopard Park. I again hiked for several hours in the surrounding rocky terrain prior to nightfall; whereas previously I had managed to find several withering plants of *Ammocharis coranica,* including one in fruit, this time there were hundreds of bulbs in fruit at the same locality. What a difference rain made in an environment that averaged 139mm of annual rainfall. I did not see any *Crinum* though.

The Tsaobis Leopard Camp was managed by a young couple. The wife remembered meeting me the previous year since few Americans ever visited the camp because it was so remote. She maintained a large collection of exotic birds, and this made an instant hit with Dave who proceeded to display symptoms of a latent ornithologist. Dave's knowledge of wildlife in Namibia impressed the lady, because she soon ushered us into an art studio to meet her husband, Peter Bruce, world famous wildlife artist. (His pastels have adorned many wildlife calendars.) What a treat! After we had admired his elephants and leopards, the four of us walked the nearby dry riverbed (a tributary of the Swakop River) for several hours looking for plants while Dave spearheaded a stimulating conversation about wildlife. Peter related that he had been commissioned to travel to Fort Worth, Texas, during July and August in order to paint several wildlife portraits at Fossil Rim Wildlife Center.

We drove to Omaruru to meet another one of Dave's friends, Ian Scheepers, a stout Afrikaner veterinarian and cactus enthusiast. The city of Omaruru was divided in half by the Omaruru River, a seasonal river. While waiting for Ian to return home, Dave and I frequented the nearby Hotel Staebe to quench our thirst. Directly across from the hotel in the flood plain of the river was a vacant field filled with huge bulbs of *C. buphanoides.* Many plants were in fruit; I measured leaves on one bulb that were 240mm wide. We spent the night at Ian's home, and he entertained us with a "lekker braai", a lavish barbecue of steak, lamb chops and sausage.

In the morning, I insisted that Dave obtain antimalarial pills before we proceeded into the field. The local family practitioner was located on the other side of the river. Ian said to follow him and he would show us the way to the physician's office. Several blocks away from his home, Ian turned down a dirt road and drove directly across the river bed which was nearly, but not entirely, dry. I was driving; I stopped near the river's edge, engaged the four-wheel drive in our rented pickup truck, and then proceeded to cross the

river bed. After less than 10m of driving, our wheels buried in sand. We had forgotten to engage the locking mechanisms on the front wheels. Ian was still laughing while he and several of his native employees extracted our vehicle from the sand with a chain winch. Thank goodness we learned our lesson when there was help available nearby.

After acquiring the antimalarials, Dave and I collected in the mountains west of Omaruru and on into the grasslands of Damaraland. We saw plenty of *Ammocharis coranica, Nerine laticoma, Pancratium tenuifolium*, and succulents, but not the plant I was seeking, *Crinum acaule*. We did observe *C. buphanoides* by the score whenever we passed near the Omaruru River or its major tributaries.

Our travels the following day were disappointing to me as we entered a very dry zone en route to Khorixas and did not sight a single *Crinum*. However, Dave was familiar with this region and promised me a treat; west of Khorixas we found a scattering of *Welwitschia mirabilis*. I quickly learned to differentiate the female plants with their cone-shaped flowering apparatuses from the males who sported a coarse branching reproductive structure. Dave related that when Welwitsch originally discovered this unique primitive genus, the plants were not flowering and Welwitsch mistook their broad curled and sprawling leaves for a *Crinum* species.

We then entered Kaokoland, a sparsely populated district in the northwestern corner of Namibia. The terrain was a mixture of mountains and rocky semi-desert scrublands. Long gone was the tarred highway, its place taken by rock and gravel. In spite of the harsh arid ecology, we did manage to find *Crinum*. It was too dry for any to be in bloom or fruit, but *C. buphanoides* and *C. forbesii* were recognized easily by their leaf morphologies. However, on two occasions, it was not possible to make an accurate identification, and specimens were collected. One species was deeply buried in sandy clay on the perimeter of the only natural vlei we saw the entire day, while the other grew in elevated sandy bushland. We spent the night as guests of Nature Conservation in Opuwo, the district capital (estimated population <1,000).

In the morning we restocked our food and drink supplies at the local "drankwinkle" or fast-foods and beverage store. Herein was my first exposure to members of the Ovahimba, a primitive tribe of nomadic hunter-gatherers residing in Kaokoland. The women were stunning, their bodies painted reddish-brown by a mixture of red earth and animal fat. Hand-made jewelry adorned their wrists and ankles, high foreheads accentuated their hair which was rolled into long slender tubes and affixed with dried mud, and they strutted about in a proud erect stance. Unfortunately the demise

of black Africa was conspicuous to us; these people were standing in line at the drankwinkle to purchase beer and liquor at 7:00a.m. The women seemed to be maintaining tribal habits and customs, but the men were discarding their native dress and adopting commercially made clothes as they succumbed into the throes of alcoholism. We could only surmise what was happening to the Ovahimba family unit, and how money, hitherto unknown to these nomads, was being raised to purchase the beer. An elderly Ovahimba woman in line in front of us purchased a pint of booze, guzzled it before she departed the premises, and outside we found her face-down on the walkway. Before the trip was over, Dave and I concluded that between alcohol, AIDS, and missionaries, primitive and rural black Africa was heading down the path to oblivion.

My mission in Kaokoland was to explore the Cunene River about the area of Ruacana Falls on the Angolan border. I had reviewed a herbarium specimen (**Leach 14510**, PRE) at Pretoria which I felt certain was *Crinum fimbriatulum*, and this specimen had been collected in soil between rocks at Ruacana Falls; it seemed likely that seeds had been originally carried down the Cunene River from central Angola and that more plants were to be found. The water level in the Cunene River was low, and no water was flowing over the falls when we arrived. Worse, we attempted to follow the primitive road west of the falls which paralleled the Cunene River, but it deliberately was not being maintained because of the military situation and became impassable after a few kilometers. We were unable to reach any stretches of the Cunene River not bordered by rock formations and mountains; flood plains where bulbous plants were likely to be found lay 60-70km further west according to local inhabitants.

We then began the long trek from Kaokoland across northern Namibia to the Caprivi. Drought was evident throughout the region. Only occasionally did we see the withered leaves of *C. rautanenianum* as we passed through Ovamboland, yet we crossed scores of dry river beds where this species grew by the thousands when the rivers carried water. The Kavango District was equally dry, an area that was virtually paralyzed because of heavy rains and flooding the previous summer. We visited the Mahango Game Reserve to observe *C. baumii*; it had rained only once the entire summer at this locality. Not a single leaf of *C. baumii* was to be found as the vlei whose banks it inhabited was completely dry and marred by old elephant tracks. In the Mahango Reserve we did find *C. subcernuum* (syn.: *C. crassicaule* Verdoorn, non Baker) populating a dried swamp bed which fell within the flood plain of the Okavango River; each plant bore only a few tattered or withered leaves. Barring a late summer monsoon, *Crinum* would not bloom in the Kavango District in 1990.

Most of the Caprivi was dry also. There had been no rain in over two weeks. Although we were successful in finding *Crinum* in multiple locations, such as *C. subcernuum* in the flood plain of the Chobe River and *C. rautanenianum* along the road to the Liambesi Meer, we never saw a single bulb that had bloomed during the summer of 1990. At several known collection sites, bulbs were completely dormant and invisible. We cut short our visitation to the Caprivi.

Having unexpected time on our hands, we decided to explore the pans about Tsumkwe in Bushmanland to look for *C. carolo-schmidtii*. The long drive to Tsumkwe was monotonous; the terrain was dense bushland overlying a rocky stratum, quite inhospitable for bulbous plants. After receiving directions in Tsumkwe, we traveled south along a two-tire-track rocky "road" for about 25km until eventually we came to Iaotcha Pan (spelled Gautcha Pan on most maps). The pan was a barren flat plain about 3 x 3km and would have made an excellent auto raceway. Near the pan we encountered several families of Bushmen, but the children were clad in shirts and shorts instead of native attire—little wonder as a van of missionaries soon arrived. We hiked through several smaller pans, washes and swamps, but all were completely dry; presumably *C. carolo-schmidtii* was dormant as it was nowhere to be seen. We did find *C. crassicaule* (syn.: *C. foetidum* Verdoorn) in a pasture, but no bulbs had bloomed. Fortunately we carried a 50 liter petrol can with us for emergencies, because the only petrol station in Tsumkwe was depleted of octane, and even with the extra cache, we barely had enough fuel to make it back to "civilization".

Because of the drought, we returned to Omaruru a day before our scheduled departure and stayed at Ian's home. While Dave prepared his 100+ pressed specimens for shipping, I decided to look one more time for Giess's *Crinum*. During the three-hour drive to the locality, I had daydreams about thunderstorms and how fortunate it would be if there had been rain at the correct spot. As I came over a hill, I noticed a beautiful view of the distant mountains, so I elected to stop and take photographs. (My 35mm camera had broken just before I departed for Africa, and I had hastily purchased a new one only a few days beforehand.) I decided to change lenses to accommodate for the distance in my planned photograph, and then I discovered a horrible error—I had made an improper exposure setting on the camera and all the photographs I had taken during the field trip had been botched. I was so embarrassed just thinking about how I would explain the disaster to Dave, since I had taken many photographs of succulents for him. By the time I reached the farms referenced by Giess, I was not in a good frame of mind—not only had I ruined Dave's pictures,

but I had not found any of the particular species I had sought during this trip because of the drought.

To make matters worse, it was immediately obvious upon arrival that no rain had fallen since our earlier visit. Pre-Namib Desert was the proper description. For hours I slowly drove the dirt roads bordering the farms while I scanned the landscape for *Crinum*. I persisted only because I didn't want to go home empty-handed. What happened then was a stroke of luck. I spotted a single plant bearing two tattered leaves about 50m from the road which through my binoculars looked like it might be a *Crinum*. The 60mm wide leaves were channeled with ciliate margins—it was a *Crinum*! I was able eventually to find about 20 plants; they were widely scattered. Although the bulbs had long underground necks and were buried deeply, they were easily extracted from the dry sandy soil. One bulb even bore a subterranean scape with two fruiting bodies resting at ground level. The fruit sported apical projections measuring 45mm long and contained dark brownish-black seeds covered with coarse fibrocapsules (papillose seeds). Giess was correct—this was not *Crinum lugardiae*.

Prior to departure, we visited Giess briefly to inform him about the successful finding of his *Crinum*. We then embarked for Johannesburg. I spent one day browsing in the nursery and herbarium at the National Botanical Institute in Pretoria before undertaking the dreaded 22+ hours of flight necessary to return home.

CHLOROPHYLL ALBINISM

Why do some bulb seedlings have strange white, yellow or pinkish leaves rather than the usual green?

It is because some seedlings lack the ability to produce chlorophyll or do not produce enough chlorophyll. Such seedlings apparently lack the correct genetic signals which would set them on the right chemical path in life.

While seedlings may emerge looking vigorous and seemingly healthy except for their unusual color, nearly all will perish; they simply have no ability to make the food necessary to survive. A few may survive and produce interesting leaf coloration or patterns but these are usually weak or smaller growing plants

Nerine seedlings, hippeastrum seedlings, some irids, crinums and occasionally other bulbs produce "albino" seedlings.

A recent planting of 150 *Hippeastrum cybister* seeds has so far yielded 110 seedlings (after 3 weeks). Of these, 19 seedlings are chlorophyll albinos.

M.V. & C.H.

SYNOPSIS OF THE GENUS *CRINUM* (AMARYLLIDACEAE) IN NAMIBIA

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Many *Crinum* species thrive in Namibia despite the arid ecology. The brief rainy season is erratic and drought is commonplace. *Crinum*, though, require a sufficient amount of summer rainfall in order to flower, and flowering may not happen every year. Reproduction is so dependent upon water that the stimulus of a single thunderstorm can trigger simultaneous flowering of nearly all local populations of *Crinum*, and the duration of flowering at a given site lasts but a few days. Since many districts are poorly accessible, finding an uncommon species in flower is a matter of chance. Also, livestock and antelope devour blooms. For these reasons, only meager quantities of herbarium specimens and color photographs exist for the rarer species.

Four monographs previously addressed the taxonomy of Namibian *Crinum*. However, these treatises were skewed because the investigators never visited Namibia; classifications were based chiefly on herbarium materials. Sölch (1960, 1969) examined only herbaria; Verdoorn (1973a) supplemented her Namibian herbaria with a few cultivated bulbs and photographs contributed by others; and Roessler (1974), confiding in Verdoorn's expertise, revised Sölch's work through field photographs supplied by Giess, curator of the National Herbarium of Namibia. While concentrating only upon Namibian materials, Sölch and Roessler did not include collections from the Namibian region known as the Caprivi; Verdoorn's account did encompass the Caprivi, although she did not examine many Namibian specimens available to Sölch and Roessler in Germany. Giess (1979) summarized the works of Verdoorn and Roessler, compiling a list of 15 species indigenous to Namibia.

Accurate determination of *Crinum* species from herbaria is beset with many problems: 1) drying obscures many important characters in *Crinum*; 2) most herbaria are not accompanied by color photographs; 3) bulb, fruit and seed morphologies are rarely described; 4) habitat descriptions are disconnected; and 5) local climatic conditions are not detailed—striking alterations in leaf morphology can be affected by an excess or deficiency of moisture. Specimen classification often is arbitrary, unless the investigator has visited the collection locality.

Cultivated bulbs must be analyzed cautiously, because greenhouse culture can evoke morphologic changes in *Crinum* that are not encountered naturally. Most notable is stunting, induced by

suboptimal pot size or by water deprivation in semiaquatic species (Lehmiller, 1987). Reduction in plant size and in number of flowers per umbel can be dramatic, and the effects upon floral parts may be non-uniform. At the opposite extreme are the changes produced by an abundance of nutrients and water: larger umbels, wider leaves and loss of undulations in leaves.

In contrast to the herbarium accounts, this investigation focused upon living plants in the field. Six Namibian field expeditions were undertaken in consecutive years 1987-1992 during the summer rainy season. All species were examined in their native habitats, including bulb, leaf, flower, fruit and seed morphologies. Field studies were conducted in other African countries for comparative analyses: South Africa (1987, 1988), Botswana (1992), Tchad (1992, 1993), Cameroun (1993) and Zambia (1994). Also, field-collected bulbs from Angola and Tanzania were acquired and cultivated for comparison purposes.

The revised classification differs greatly from that presented in the combined Verdoorn-Roessler analysis; only three previously recognized species remain unchanged: *C. buphanoides, C. macowanii* and *C. baumii.* All morphological descriptions incorporated into the classification key or discussed elsewhere were acquired from living plants unless indicated. Since the recorded sightings number in the hundreds, only the districts are listed where species were sighted. As this communication is not intended to be a comprehensive review, detailed descriptions are not provided except for the new species. The commentary addresses controversial areas surrounding the herbarium accounts and problems of species differentiation, including elaborations and modifications of data provided in previous field notes (Lehmiller, 1992a, 1992b).

KEY TO THE GENUS *CRINUM* IN NAMIBIA

1. Flowers actinomorphic, stamens spreading; seeds smooth (subgenus *Crinum*).....2
1. Flowers zygomorphic, stamens fasciculate; seeds smooth or papillose (subgenus *Codonocrinum*).....4
2. Fruit not beaked; flowers sessile, umbel 1-2 flowered; leaves <5mm wide, spirally arranged.....*C. baumii*
2. Fruit beaked; flowers pedicellate, umbel many flowered; leaves >75mm wide, rosulate or distichous.....3
3. Leaves rosulate, sometimes undulate; umbel 8-30 flowered..... .....*C. subcernuum*
3. Leaves distichous, undulate; umbel 13-54 flowered...*C. buphanoides*
4. Seeds papillose; leaves rosulate.....5
4. Seeds smooth; leaves rosulate or distichous.....9

5. Fruit beaked; leaves narrow, margins not ciliate; scape usually subterranean.....6
5. Fruit beaked; leaves broad, margins ciliate; scape seldom subterranean.....7
6. Leaves 4-8mm wide, margins smooth; umbel 1, rarely 2-flowered.....*C. walteri*
6. Leaves 6-17mm wide, margins with spaced minute teeth; umbel 1-4, seldom 5-6 flowered.....*C. acaule*
7. Leaves 22-67mm wide; flowers sessile, but fruit usually pedicellate; umbel 1-8 flowered.....*C. giessii*
7. Leaves >80mm wide; flowers usually pedicellate.....8
8. Leaves 80-120mm wide, green, sprawling and bearing prominent longitudinal nerves, not undulate; umbel 2-15 flowered...*C. harmsii*
8. Leaves 100-210mm wide, blue-green, broadly channeled and often undulate; umbel 2-17 flowered.....*C. crassicaule*
9. Fruit not beaked, red; leaves >100mm wide, margins ciliate, rosulate; umbel 8-39 flowered.....*C. forbesii*
10. Fruit beaked; leaves rosulate.....11
10. Fruit umbilicate; leaves rosulate or distichous.....13
11. Leaves V-shaped in cross section with a scabrous dorsal ridge, margins scabrous; flowers sessile, umbel 2-11 flowered.. *C. verdoorniae*
11. Leaves channeled, margins scabrous; flowers pedicellate.....12
12. Leaves <25mm wide, narrowly channeled, usually not undulate; umbel 2-14 flowered.....*C. lugardiae*
12. Leaves >40mm wide, broadly channeled, usually undulate; umbel 4-26 flowered.....*C. macowanii*
13. Leaves broadly channeled, flexible, margins scabrous, >30mm wide, rosulate; umbel 2-9 flowered.....*C. paludosum*
13. Leaves deeply channeled/U-shaped, sturdy, margins denticulate....14
14. Leaves <20mm wide, rosulate; umbel 1-2, rarely 3 flowered.....
.....*C. carolo-schmidtii*
14. Leaves >30mm wide, distichous; umbel 1-7 flowered.
.....*C. rautanenianum*

1. *Crinum baumii* Harms, Kunene-Sambesi Expedition, p. 199, 1903.
Ammocharis baumii (Harms) Milne-Redhead & Schweickerdt. **J. Linn. Soc. Bot.** 52:187, 1939.

Districts sighted: **Kavango**.

The paucity of *C. baumii* among herbaria reflects its diminutive stature, not its sparse occurrence. Prior to Verdoorn's account (1964), a cultivated bulb was unknown in botanical gardens.

Milne-Redhead and Schwieckerdt (1939) classified this bulb as an "advanced species" of *Ammocharis*, although they never observed a living specimen. *Ammocharis* and *Crinum* are related genera and they may be confused in herbaria. These genera differ by: 1) fruit of *Ammocharis* bear three shallow furrows in the pericarp, whereas fruit of *Crinum* lack furrows; 2) leaves of *Ammocharis* are distichous and biflabellately arranged, while leaves of *Crinum* are rosulate or distichous but never biflabellately arranged; and 3) leaves of *Crinum* exhibit clasping at the base, a feature absent in *Ammocharis*. *Crinum baumii* satisfies only two of these differentiating criteria: its leaves do not clasp one another at the base. However, leaves of *C. baumii* are so narrow that clasping at the base is unattainable. Hence, its classification into the genus *Crinum* is not jeopardized.

2. *Crinum subcernuum* Baker, **Gard. Chron.**, ser. 2, 16:180, 1881.
Syn.: *C. menyharthii* Baker, **Flora of Trop. Africa** 7:395-396, 1998.
C. crassicaule Verdoorn, non Baker (1888), **Bothalia** 11:32-33, 1973, and **Flow. Pl. Afr.** 42:t.1676, 1973.

Districts sighted: **Kavango, East Caprivi**.

Crinum subcernuum is endemic to marshy areas within the flood plains of the Okavango and Zambesi Rivers; it also occurs sporadically throughout East Caprivi. Natives residing in East Caprivi grind bulbs to produce a paste purported to be a skin bleaching agent.

Verdoorn (1969b, 1973a, 1973b) confused the identity of this species, a topic addressed under *C. crassicaule* Baker. However, Verdoorn (1973a) acknowledged that *C. subcernuum* might be the correct name of this plant.

3. *Crinum buphanoides* Welwitch ex Baker, **J. Bot.** 16:195-196, 1878.
Syn.: *C. leucophyllum* Baker, **Bot. Mag.** 110:t.6783, 1884.
C. amboense Baker, **Bull. Herb. Boissier**, ser. 2, 3:666, 1903.

Districts sighted: **Kaokoland, Damaraland, Omaruru, Karibib, Outjo, Ovamboland, Rehoboth, Otjiwarongo, Maltahöhe**.

Crinum buphanoides is widely distributed in Namibia and is the most common species encountered in the western districts. This species is locally abundant near the cities of Omaruru, Outjo and Opuwo. It frequently inhabits the banks or beds of temporary rivers and streams, but it also occurs in non-riverine habitats.

4. *Crinum walteri* Overkott, **Mitt. Bot. München** 1:444-445, 1954.
Syn.: *C. minimum* Sölch, non Milne-Redhead (1947), **Prodomus einer Flora in Südwest-Afrika** 150:4-8, 1969.

C. minimum Verdoorn, non Milne-Redhead (1947), **Flow. Pl. Afr.** 40:t.1577, 1969a, and **Bothalia** 11:40, 1973a.

C. minimum Roessler, non Milne-Redhead (1947), **Mitt. Bot. München** 11:523-544, 1974.

Districts sighted: **Kaokoland, Karibib, Outjo, Damaraland including Farm Buleah, the type locality), Omaruru, Mariental**.

Crinum walteri shares many features with *C. acaule* Baker. Bulb shape, floral parts, fruits, seeds and habitat are similar, although *C. walteri* is a distinctly smaller bulb and bears 1-flowered umbels. Differentiating characteristics between these two species reside in their leaves: narrowly channeled with smooth margins and <9mm wide in *C. walteri*; broadly channeled with irregularly spaced teeth on the margins and 6-17mm wide in *C. acaule*.

Milne-Redhead's decision (1947) to classify *C. minimum* with *Crinum* subgenus *Stenaster* Baker (1888) [now correctly subgenus *Crinum*] proved controversial since several elements conflicted with the required criteria: zygomorphic flowers and declinate anthers. Although its perianth segments were narrow, this species conformed to the morphology of *Crinum* subgenus *Codonocrinum* Baker. All subsequent accounts adopted the latter position (Sölch, 1960, 1969; Verdoorn, 1969a, 1973a; Roessler, 1974).

Crinum minimum Milne-Redhead is an unorthodox species, a fact illustrated in Milne-Redhead's two photographs filed with the type specimen. One photograph of the type locality shows many bulbs bearing slender erect leaves and several bulbs displaying above-ground scapes with solitary inclined buds (buds immediately prior to anthesis). The length-to-width ratio of these buds is approximately 10:1, far exceeding the ratio for inclined buds in *Crinum* subgenus *Codonocrinum;* the latter ratio is <6:1, usually 4-5:1. Milne-Redhead's description, apparently from living plants, specifies the perianth segments as narrowly lanceolate and very acute, 65-90mm long and 10-14mm wide. In the type specimen (***Milne-Redhead 1761***, K) from Zambia, the length:width ratio of the segments has been exaggerated to 10-14:1 from drying. These are exceptionally narrow perianth segments for *Crinum* subgenus *Codonocrinum*. Another Zambian specimen (***D.B.F. 9024***, K) demonstrates identical morphological features. In Milne-Redhead's second photograph (Fig. 1), a flowering bulb is shown on a windowsill, presumably collected in bud the previous day. The narrow perianth segments are widely patent and reflexed, almost mimicking the floral pattern of *Crinum* subgenus *Crinum*; unfortunately the stamens are not discernable in the photograph. Some species within *Crinum* subgenus *Codonocrinum* exhibit patent perianth segments at night (Lehmiller, 1992b), but in the author's experience, such exaggerated patency

is commonly observed among interspecific hybrids between *Crinum* subgenus *Codonocrinum* and *Crinum* subgenus *Crinum*.

Crinum minimum does not resemble *C. walteri* (Fig. 2), yet these two species have been equated by previous investigators. Apparently these investigators were unaware of Milne-Redhead's photographs, else they would not have confused *C. minimum* with a species bearing a funnel-shaped flower with broad oblong perianth segments 20-33mm wide. Additional differences between these two species include: 1) leaves: erect and very narrow, about 2.5mm wide, and so narrow that Milne-Redhead remarked that they did not clasp at the base in *C. minimum*, whereas leaves of *C. walteri* are arching or sprawling on the ground, broader, 4-8mm wide and clasp at the base; 2) scape: *C. minimum* has an above-ground scape 40-100mm long which is demonstrated in Milne-Redhead's on-site photograph, while *C. walteri* has a subterranean scape that may elongate and appear above ground in fruit but remains <40mm long; and 3) fruit: one Zambian specimen (***Prince 18***, NDO) displays a seed-bearing fruit which is not beaked, whereas fruit of *C. walteri* sport a long, thick apical beak. (Milne-Redhead did not mention fruit and seeds in her description.) Bulbs of *C. walteri* possess a cylindrical basal growth plate 15-20mm long and about 15mm diameter; it would be impossible to position a flowering bulb of *C. walteri* on a windowsill as shown in Milne-Redhead's photograph of *C. minimum*. The bulb illustrated as "*C. minimum*" in Verdoorn's accounts (1969a, 1973a) was collected in the Gobabis District of Namibia (**Tölken 1300**, PRE); it is *C. walteri*, but the umbel is faded.

Crinum humilis A. Chev., a small uniflowered species of *Crinum* subgenus *Codonocrinum* with striped perianth segments and smooth-edged leaves from West Africa, can be difficult to separate from *C. walteri* in herbaria. Differentiating characteristics include: 1) bulb neck: surrounded by a collar of bulb scales forming vertical, wire-like projections in *C. humilis*, a feature absent in *C. walteri;* 2) scape: 40-100mm long at anthesis in *C. humilis*, while the scape of *C. walteri* is subterranean; 3) fruit: reddish-brown with a short apical beak 3-10mm long in *C. humilis*, versus green or rust tinged, with a prominent apical beak 75-90mm long in *C. walteri*; and 4) seeds: smooth, green, compressed, stacked in six vertical columns, and numerous, 24-72 per fruit in *C. humilis*, while the seeds of *C. walteri* are papillose, black, large, ovoid to partially angulated, and few, 1-8 per fruit.

5. *C. acaule* Baker, **Flora Capensis** 6:532, 1897.

Syn.: *C. parvibulbosum* Dinter ex Overkott, **Mitt. Bot. München** 1:444, 1954.

Districts sighted: **Karibib, Damaraland, Omaruru**.

Giess recognized the occurrence of *C. acaule* in Namibia; he prepared a dried specimen (***Giess 10186***, WIND) from a bulb collected and photographed in the Namib Desert by Maedler. Roessler (1974) examined Giess's specimen and Maedler's photograph but refused to accept that *C. acuale* existed outside of Zululand, South Africa, even though the leaves measured 11mm wide and bore small teeth on their margins; Roessler classified the specimen as a variety of "*C. minimum*".

Crinum acaule has seldom been recorded in Namibia, probably because it prefers the harsh semi-desert ecology of western regions near the Namib Desert, especially Damaraland. It is not rare; rather the opportunities to observe it are limited due to remote locations and sparse rainfall. At the junction of Farm Roads 2612 and 2628 in Damaraland, the author once observed a red-sandy field filled with blooming plants that stretched as far as the eye could see.

The sandy soils of Damaraland resemble the habitat of *C. acaule* in Zululand and Tongaland, Natal Province, South Africa, but the annual rainfall is greater and occurs with more regularity in the latter localities. Bulbs in Tongaland and Zululand grow larger, and their foliage often persists throughout the summer months, whereas foliage on the smaller Namibian bulbs is episodic and may not even emerge during a given year due to insufficient rainfall. The physiology of the Namibian bulbs is so conditioned to rainfall that should heavy rains ensue, the bulbs may respond by sending forth scapes that emerge above ground instead of remaining subterranean.

6. *Crinum giessii* Lehmiller, sp. nov. TYPE: **Namibia**. Karibib District, Farm Ruimte (KAR 125), near sand dunes 3.5km east of the Namib Desert Park entrance, 9 February 1974, ***Giess 13272*** (holotype, WIND). Figure 3.

Species *C. harmsii* Baker affinis, sed statura parva, sessilifloribus, et nervifoliis carentibus differt.

Bulb ovoid, solitary, covered with a brown papery tunic, 40-80mm diam., tapering into an underground neck 95-155mm long. Leaves 4-7, 70-500mm long and 22-67mm wide, rosulate, arching, broadly channeled, sometimes with undulate edges, lacking a depressed midrib, containing minute wooly fibers when torn apart with torn surfaces emitting an unpleasant odor; margins prominently ciliate, shiny green turning bluish-green as moisture ebbs, all but new leaves growing out with truncated ends. Scape green, short, subterranean to 150mm long. Spathe valves papery at anthesis. Umbel 1-8 flowered; flowers zygomorphic, connivent to form a funnel, sessile but with pedicels appearing during fruit formation, 5-30mm long, scented. Perianth tube curved at anthesis,

green, 75-133mm long. Perianth segments lanceolate, distally curved, apiculate, white with a dark pink dorsal stripe, unequal with the inner broader, 90-119mm long and 15-31mm wide. Filaments white, unequal with the inner longer, 60-93mm long; anthers curved at maturity; pollen light yellowish tan; style white, turning purplish-red distally, 87-107mm long; stigma minutely trifid. Ovary shiny green, about 10mm diameter. Fruit subglobose,

Figure 1. *Crinum minimum* Milne-Redhead. Photograph filed by Milne-Redhead with the type specimen. (Courtesy of K).

Fig. 2. *Crinum walteri* Overkott. Namibia, Damaraland District, 23.5km west of Omatjette, 21 January 1991.

Figure 3B. *Crinum giessii* Lehmiller. Pre-Namib Desert habitat: Namibia, Karibib District, Farm Onanis, 7 March 1990.

Figure 3A. *Crinum giessii* Lehmiller. Type specimen, **Giess 13272**, WIND.

with an apical beak 45-75mm long, green, acquiring a partial rust tinge at maturity, indehiscent, 32-41mm diameter; seeds few per fruit, ovoid or angled by pressure from adjacent seeds, papillose, covered with a water-absorbing fibrocapsule about 1mm thick, turning black at maturity and acquiring an unpleasant odor, 17-22mm diameter.

Habitat: Bleak arid ecology with an erratic summer rainy season; annual rainfall <40mm. Pre-Namib Desert terrain in sandy flats.

Paratypes: **Namibia**. Karibib District: Farm Donkerhoak West (KAR 91), 11 February 1974, ***Giess 13301*** (WIND); Farm Onanis (KAR 121), 9 February 1974, ***Giess 13290*** (WIND).

Districts sighted: **Karibib**.

In 1974, Giess discovered what he believed was an undescribed *Crinum* species adjacent to the Namib Desert Park. He sighted the species on three different farms in pre-Namib Desert terrain, a bleak arid ecology with annual rainfall of less than 40mm. His discovery was fortuitous owing to exceptional rains. Giess photographed the plants and prepared multiple herbarium specimens; he shipped the photographs and mounts to Roessler in Germany for determination. Roessler (1974), who thought that *C. lugardiae* N.E. Brown and *C. macowanii* Baker were closely related and difficult to separate in herbaria, decided that designation of a new taxon was premature. He felt that Giess's plant likely represented a local broad-leaf variety of *C. lugardiae* or possibly a transitional form between *C. lugardiae* and *C. macowanii*. Roessler remarked that the habitat displayed in Giess's photographs seemed appropriate for *C. lugardiae*.

Giess was certain that Roessler had erred; Giess remarked that the leaves were too wide for *C. lugardiae*, and that the habitat was desert sand instead of riverine. In March 1990, following an interview with Giess, the author set out to find Giess's *Crinum*. Only Farm Onanis had received rainfall during the summer of 1990; 8mm of rain was recorded during a thunderstorm in February. This rainfall was sufficient to bring forth a few leaves (Fig. 3B), and one bulb had bloomed with the subterranean scape bearing a solitary fruit (Fig. 3C). The leaves had ciliate margins and measured to 65mm wide, the seeds were papillose and black, and the bulb was not encased within a thick tunic; definitely not representative of *C. lugardiae* or *C. macowanii*. The farms were visited again in late January 1991, but none had received any rain; an adjacent farm had been bathed by a large thunderstorm and was green with lush grasses. In January 1992, a small thunderstorm brought rain to a portion of Farm Onanis, and about 10 days later, four bulbs were discovered in bud. One bulb which was transplanted into a pot,

flowered the next day (Fig. 3D).

Crinum giessii is differentiated from *C. harmsii* Baker, a larger species, by its leaves which become undulate as moisture ebbs (Fig. 3B), a feature never encountered in *C. harmsii* whose sturdy sprawling leaves are marked with prominent nerves. Leaf margins of *C. giessii* are conspicuously ciliate, whereas leaf margins of *C. harmsii* are distinctly scabrous as well as ciliate. Flowers of *C. harmsii* emit a delightful, perfume-like scent identical to *C. graminicola* Verdoorn, while the scent of *C. giessii* mimics the astringent, somewhat unpleasant odor of *C. macowanii* Baker. *Crinum harmsii* inhabits red sandy soils about the fringes of the Kalahari Desert, an area experiencing higher rainfall than the habitat of *C. giessii*—coarse ocean sand adjacent to the Namib Desert that may not even receive rainfall in a given year.

7. *Crinum harmsii* Baker, **Kunene-Sambesi Expedition**, p.565, 1903.

Syn.: *C. graminicola* Sölch, non Verdoorn (1953), **Prodomus einer Flora in Südwest-Afrika** 150:4-8, 1969.

C. graminicola Roessler, non Verdoorn (1953), **Mitt. Bot. München** 11:523-544, 1974.

Districts sighted: **Okahandja, Windhoek, Mariental, Hereroland East.**

Crinum harmsii has been confused with *C. graminicola* (Sölch, 1969; Roessler, 1974; Lehmiller, 1992a, 1992b). Similarities are striking, including a perfume-like floral scent. The differentiating character resides in their seeds: smooth and green in *C. graminicola*; papillose and tan, turning black at maturity in *C. harmsii*. Since seeds are lacking in herbaria, accurate separation of these two species is presumptive. Umbel size may be helpful: the umbels of *C. harmsii* are smaller, usually 3-7 flowered, while the umbels of *C. graminicola* often number 15-20+ flowers; an area of overlap exists between these ranges. Perianth segments of *C. harmsii* bear only a thin, pink dorsal stripe, whereas the segments of *C. graminicola* are diffusely pinkish-red or have a broad, brightly pigmented dorsal stripe. The type specimen of *C. harmsii* (***Baum*** s.n., K) originated from Southeast Angola in a sandy plateau near a tributary of the Okavango River. The author has observed this species east of the Okavango Swamps in Ngamiland, Botswana; color photographs and a pressed specimen (***Plowes 7029***) from this location reside in the personal herbarium of D.C.H. Plowes in Zimbabwe. *Crinum graminicola* does not occur in Namibia; rather it is found in the Transvaal of South Africa and in Zimbabwe.

Crinum papillosum Nordal of Tanzania and Kenya is probably conspecific with *C. harmsii*. Nordal (1977) thought *C. harmsii* was

possibly related to *C. papillosum;* she was not aware that *C. harmsii* had black papillose seeds.

8. *Crinum crassicaule* Baker, **Handbook of the Amaryllidaceae**: 85 (1888).

Syn.: *C. foetidum* Verdoorn, **Bothalia** 10:56-58, 1969.

Districts sighted: Gobabis, Rushmanland, Grootfontein, Ovamboland.

In October 1861, Thomas Baines (1864) sketched a watercolor of an unknown amaryllid that had been collected by his traveling companion in Ngamiland, Botswana. Quoting Baines: "I sketched a very beautiful umbel of white and pale purple flowers brought home by Chapman, apparently a kind of amaryllis....The flower had been too long gathered to restore itself to form when placed in water, but I believe that when fully opened they turn gracefully outward, like the many similar flowers of the country". The specimen consisted only of a flowering umbel as the leaves had yet to emerge. Baines attempted to reconstruct the umbel in his painting, but the result was a *Crinum* with a peculiar floral pattern. The dried specimen consisted of an 11-flowered umbel with 10 flowers in bud and the remaining flower detached and withered; Baines displayed the withered flower in his painting but promoted all the buds to anthesis. However, Baines wrote in the margin of the painting that the umbel was badly faded and that the perianth segments were more recurved in fresh flowers than displayed in the painting. Adjacent to his commentary, he penciled a small funnel-shaped flower typical of *Crinum* subgenus *Codonocrinum*. Baines also pressed the specimen and sent it to Kew. Baker (1888) classified the depauperate scape as a new species and placed it in *Crinum* subgenus *Crinum*. The original handwritten identification on the holotype specimen stated: "*Crinum crassicaule* Baker. South trop. Africa. Oct.Nov.1861. Coll. T. Baines". (The "Nov." date becomes important.)

When he painted the faded umbel, Baines (1864) was camped at Köbis or Koobie Wells, which he indicated on his meticulous map as lying between Lake Ngami and Ghanzi. He wrote on the October painting that the flower originated from the flats at Köbis. Then in November, 1861, Baines painted two additional *Crinum* while still camped at Köbis, both of which belonged to *Crinum* subgenus *Codonocrinum*; Brown (1909) identified one painting as *C. crassicaule* Baker and annotated it accordingly (the other painting depicted *C. lugardiae* N.E. Brown although no identification is indicated on the painting). Brown was working to identify specimens collected during Major Lugard's 1896-1898 expedition to Kwebe

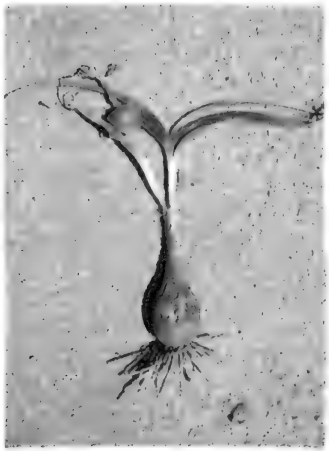

Figure 3C. *Crinum giessii* Lehmiller. Bulb with solitary fruit, Farm Onanis, 7 March 1990.

Figure 3D. *Crinum giessii* Lehmiller. Flowering bulb transplanted into pot, collected the previous day, Farm Onanis, 13 January 1992.

Photos: David Lehmiller

Fig. 4B. *Crinum verdoorniae* Lehmiller. Flood plain of Zambesi River habitat: Namibia, East Caprivi District, Katima Mulilo, northwest edge of city near the old soccer field, 2 February 1989.

Fig. 4A. *Crinum verdoorniae* Lehmiller. Type specimen, **Codd 7141**, PRE.

Hills in Ngamiland, when he equated a painting by Mrs. Lugard (#45) with Baines's paintings and the type specimen. Brown published an emended detailed description of *C. crassicaule* Baker; he also wrote on Baines's November 1861 painting that it represented the type illustration.

Verdoorn muddled the identity of *C. crassicaule* Baker. She only examined photographs of Baines's paintings (Verdoorn, 1969), and since she was unaware of the commentary and the penciled drawing of the funnel-shaped flower in the margin of the October 1861 watercolor, she concluded that the October and November 1861 paintings represented two different taxa. When defining *C. foetidum*, Verdoorn acknowledged that Baines's November 1861 painting was conspecific with *C. foetidum*. Verdoorn dismissed Brown's (1909) description of *C. crassicaule* Baker, claiming that it represented more than one taxon, and then she implied that Mrs. Lugard's #45 painting belonged either to *Crinum* subgenus *Stenaster* [now considered in subgenus *Crinum*] or *Crinum* subgenus *Crinum*. Yet Mrs. Lugard's #45 painting depicted a funnel-shaped flower with fasciculate stamens that was characteristic for *Crinum* subgenus *Codonocrinum*!

Verdoorn (1973b) then erroneously portrayed *C. crassicaule* Baker in a separate account. Herein, she stated that Baines's type specimen had originated from the Okavango Swamps in Ngamiland. To the contrary, the Okavango Swamps lay 50-100km north of Lake Ngami, wherein Köbis was positioned about 70km southwest of Lake Ngami. In another contemporary account, Verdoorn (1973a) stated that Baines's November 1861 painting had been accomplished in Namaqualand, Namibia, instead of Köbis. The plant which Verdoorn purported to be *C. crassicaule* Baker was *C. subcernuum* Baker, a riverine/swamp species indigenous to the Okavango Swamps and to the flood plain of the Zambesi River; the latter species should be completely alien to the sandy flats of the Kalahari Desert which characterize the region south of Lake Ngami. Furthermore, *C. subcernuum* (*C. crassicaule* Verdoorn, non Baker) did not possess the funnel-shaped flowers of *Crinum* subgenus *Codonocrinum*; rather, *C. subcernuum* belonged to *Crinum* subgenus *Crinum*. Nordal (1977) also recognized several of Verdoorn's errors.

During a 1992 field expedition to Ngamiland, the author found *C. crassicaule* Baker to be endemic in flat semidesert terrain south of Lake Ngami, an ecology which paralleled eastern Namibia. The bulb was common in sandy flats near the Kuke Animal Control Gate on the road to Ghanzi, a locality approximating Baines's campsite at Köbis.

Immature seeds of *C. crassicaule* are sepia colored as described by Verdoorn (as *C. foetidum*), but they turn black at maturity as

reported in *C. papillosum* Nordal (1977). Papillose seeds of all Namibian species listed in Sections 4.-8. of the key are covered with a spongy fibrocapsule that is about 1mm thick and highly water absorbent; the covering turns black or dark brownish-black at maturity and acquires a disagreeable odor, with the seeds of *C. crassicaule* imparting a potent fetid smell. Nordal likened *C. crassicaule* as being closely related to *C. papillosum*; however, the former is a much larger bulb with blue-green undulate leaves and dark anthers. *Crinum harmsii* is the appropriate-sized bulb possessing green non-undulate leaves and yellow anthers which favorably compares with *C. papillosum*.

9. *Crinum forbesii* (Lind.) Schultes emend. Herb., **Amaryllidaceae**: 266-267, 1837. *Amaryllis forbesii* Lind., **Trans. Hort. Soc. London** 6:87 and 6:285, 1826.

Syn.: *C. delagoense* Verdoorn, **Flow. Pl. Afr.** 35:t.1389, 1962.
C. stuhlmannii Baker, **Flora of Tropical Africa** 7:378, 1898.

Districts sighted: **Okahandja, Otjiwarongo, Grootfontein, Tsumeb, Outjo, Kaokoland**.

Crinum forbesii is the largest Namibian *Crinum*. Giess photographed an enormous bulb bearing leaves 300mm wide. This species is readily recognized by its large bright red fruit which stand out vividly in contrast to the surrounding greenery.

The illegitimacy of *C. delagoense* Verdoorn has been discussed elsewhere (Lehmiller, 1992c). The longtime accepted epithet of *C. forbesianum* (Lind.) Herb., often misrepresented as *C. forbesianum* Herb., must be corrected under the rules of the **International Code of Botanical Nomenclature** to *C. forbesii* (Lind.) Schultes emend. Herbert.

Unless exceptionally wide leaves or large umbels are included in the materials, separating *C. forbesii* from *C. harmsii* can be problematic in herbaria since fruit and seeds are rarely represented. Pedicel length is the best indicator: <30mm long in *C. harmsii*, and usually >30mm long in *C. forbesii*.

10. *Crinum verdoorniae* Lehmiller, sp. nov. TYPE: **Zambia**. Barotseland, Nangweshi, on the Zambesi River, specimen cultivated at Pretoria, February, 1955, **Codd 7141** (Holotype, PRE). Figure 4.

Syn.: *C. kirkii* Verdoorn, non Baker (1880), **Bothalia** 11:38-39, 1973.

Folia a *Crino* crista mediodorsali scabrida differt.

Bulb spherical, 72-160mm diameter, tapering into a stout underground neck 50-125mm long; basal offsets sometimes produced. Leaves 11-19, forming a rosette, erect to suberect, widest at the

base, V-shaped in cross section with a transluscent scabrous sharp ridge traversing the dorsal apex of the V, mildly thickened in the mid-portion but lacking a distinct midrib, containing thick wooly fibers when torn apart; margins scabrous, green, usually with intact apices, 780-940mm long and 57-112mm wide. Scape stout, 460-800mm long. Spathe valves enveloping the perianth tubes at anthesis, containing wooly fibers when torn apart. Umbel 2-11 flowered; flowers zygomorphic, sessile, scentless. Buds greenish with deep maroon stripes on dorsal perianth segments, inclining well below the horizon before rising to suberect posture at anthesis. Perianth tubes curved, 120-150mm long. Flowers nocturnally opening, wide-funnel shaped with patent perianth segments, becoming tubular and drooping the following day. Segments white with dorsal maroon stripes and faded ventral stripes, unequal with the inner broader, 107-138mm long and 25-35mm wide; tipped with a dried brown apiculum 4-7mm long. Filaments white, unequal with the inner longer, 73-90mm long; anthers white in buds, becoming curved at maturity and turning black; pollen gray-white. Style white turning purple distally, 78-105mm long; stigma trilobed. Fruit oblong to ovoid, with a short apical beak, shiny green turning yellowish at maturity, indehiscent; seeds few per fruit, ovoid, smooth, green, 14-22mm diameter.

Habitat: known only from the upper region of the Zambesi River. Occurring in sandy to sandy-clay soils in the immediate flood plain of the river; also along tributaries of the Zambesi River in Zambia. Full sun exposure, in competition with local grasses.

Other material examined: **Namibia**. East Caprivi: Mpilila Island, ***Killick and Leistner 3384*** (PRE); Schuchmannsburg, ***Vahrmeijer 2204*** (PRE); Katima Mulilo, ***van Zyl 106B*** (PRE).

Districts sighted: **East Caprivi**.

This species has been collected only in the immediate flood plain of the upper Zambesi River and its tributaries. Few herbarium specimens exist, although the bulb is common in the vicinity of Katima Mulilo in Namibia and near Victoria Falls in Zambia.

The distinguishing feature which sets *C. verdoorniae* apart from other members of *Crinum* subgenus *Codonocrinum* with striped flowers is its unique leaf morphology. The leaf is V-shaped in cross section with a discrete median scabrous ridge traversing the dorsal apex of the V; the histologic morphology of the ridge correlates with the epidermal configuration of the leaf margins; a distinct midrib is lacking. The only other species whose leaf possesses a median dorsal ridge is the West African *C. brousonnetii* (Redouté) Herb., although its ridge is inconspicuous, resembles a crease, and rarely bears sporadic minute teeth. These two species would never

be confused in the field because their leaf morphologies differ strikingly: erect to suberect leaves with V-shaped cross section and no distinct midrib in *C. verdoorniae*; arching, broadly channeled leaves with coarse undulate margins and a midrib with a V-shaped ventral keel in *C. brousonnetii*. Additional differences include: 1) leaves: smaller, closer-spaced nerves and coarser, more numerous wooly fibers in *C. verdoorniae*; and 2) fruit: dark red at maturity and containing numerous, small, compressed seeds stacked in six vertical columns in *C. brousonnetii*, whereas fruit of *C. verdoorniae* are dull yellow at maturity and contain only a few, larger ovoid seeds.

Verdoorn (1973a) initially recognized this plant, deciding that its morphology best correlated with the botanical illustration figured for the East African *C. kirkii* Baker (1880); Verdoorn expressed uncertainty about the identification as she never examined living material of *C. kirkii*. However, leaves of *C. kirkii* significantly differ: in arching broadly channeled leaves with undulate and crisped margins, a prominent depressed midrib, and absence of a median dorsal ridge. Also, fruits of *C. kirkii* are conspicuously crimson or rose colored and very large.

Nordal (1982) includes *C. verdoorniae* (as *C. kirkii* sensu Verdoorn, non Baker) as a synonym of *C. zeylanicum* L. sensu Nordal. In the author's opinion, the latter represents a heterogenous group rather than a single species and includes a cultivated West African hybrid. Moreover, leaves of *C. zeylanicum* L. sensu Nordal are described as lanceolate and keeled with a distinct midrib; as such, they are inconsistent with the leaves of *C. verdoorniae*.

11. *Crinum lugardiae* N.E. Brown, **Gard. Chron**. 34:49, 1903.

Syn.: *C. polyphyllum* Baker, **Bull. Herb. Boissier** 3:667, 1903.
C. crispum Phillips, **Flow. Pl. Afr**. 14:t.532, 1934.
C. occiduale Dyer, **Herbertia** 15:31-33, 1948.
C. carolo-schmidtii Verdoorn, non Dinter (1914), **Flow. Pl. Afr**. 41:t.1629, 1972.

Districts sighted: **Windhoek, Rehoboth, Gobabis.**

This species was first painted by Baines in Ngamiland, Botswana, in 1861 and is now lodged in the archives at Kew. Ironically, 36 years later, the type specimen was painted and collected by Mrs. Lugard (**Mrs. E.J. Lugard 43**, K) in Ngamiland.

The Namibian variety of *C. lugardiae* is a small statured plant; its largest leaves are usually <25mm wide. Leaves are deeply channeled, and, if undulations are manifested, they are inconspicuous. In contrast, undulations are often prominent in South African

varieties of this species, and a larger variety occurs in South Africa which rivals *C. macowanii* Baker in size. When cultivated in rich soil with abundant moisture, leaves of Namibian *C. lugardiae* lose their distinctive channeled contour; the leaves become flaccid and acquire a glossy sheen. The latter aberration led to an erroneous identity, *C. occiduale* Dyer (1948). In this instance, unknown *Crinum* bulbs collected in Namibia were sent with an accompanying photograph to James in California. James (1941) published an article which included the Namibian photograph; the flowering bulb possessed deeply channeled leaves typical of a Namibian *C. lugardiae*. James sent one of the bulbs to Dyer who mistakenly identified it as a new species. Dyer's photograph of his cultivated bulb displayed flaccid glossy leaves.

Verdoorn received a field-collected bulb from the Gobabis District of Namibia; the bulb, accompanied by a pressed specimen (**Tölken** PRE 37465), was submitted with a presumptive identity of *C. lugardiae*. Following cultivation, Verdoorn (1972a, 1973a) misidentified the bulb as *C. carolo-schmidtii* Dinter and published a painting of the bulb in flower—the illustrated tubular-shaped flowers with pigmented perianth segments and black anthers typified *C. lugardiae*. Perhaps Verdoorn was misled by the flaccid leaves in her cultivated bulb which lacked undulations and thereby differed from the Transvaal varieties personally known to her. Verdoorn recognized it as conspecific with *C. occiduale* as she and Dyer were coworkers, and she included *C. occiduale* as a synonym for *C. carolo-schmidtii* Verdoorn, non Dinter. Roessler (1974) also saw the discrepancies in Verdoorn's illustration and remarked how it was incorrect and misleading.

12. *Crinum macowanii* Baker, **Gard. Chron**. 9:298, 1878.
Syn.: *C. pedicellatum* Pax, **Bot. Jahrb. Syst**. 15:142, 1893.
C. gouwsii Traub, **Herbertia** 10:38-41, 1954.

Districts sighted: **Kaokoland, Okahandja, Otjiwarongo, Grootfontein, Outjo, Omaruru, Karibib, Windhoek**.

This Namibian species occurs along the banks of small temporary rivers and streams. Plants frequently congregate about the entrances to drainage pipes passing beneath the highways.

13. *Crinum paludosum* Verdoorn, **Flow. Pl. Afr**. 39:t.1523, 1968.
Syn.: *C. carolo-schmidtii* Roessler, non Dinter (1914), **Mitt. Bot. München** 11:523-544, 1974.

Districts sighted: **Maltahöhe, Otjiwarongo**.

The vlei at Farm Sandhof qualifies as a floral wonder of the

world (see Giess, 1979; Lehmiller, 1992a); a pictorial photograph adorns the postcard displays in many Namibian tourist shops. This giant but shallow vlei harbors millions of *C. paludosum* bulbs which bloom simultaneously should the vlei temporarily fill with water following a summer rainstorm; the latter is a sporadic occurrence at best, since the locality is exceedingly arid. If the vlei does not fill with water, the bulbs remain entirely dormant. The owner of Farm Sandhof remarked that 14 years once elapsed between blooming events. In contrast, the small vlei at Farm Wewelsburg is located in a higher rainfall area (Otjiwarongo District); the bulbs of *C. paludosum* within this vlei bloom nearly every summer.

14. *Crinum carolo-schmidtii* Dinter, **Neue und bekannte Pflanzen Deutsch-Südwest-Afrika**: 26, 1914.

Districts sighted: **Kavango, East Caprivi.**

Dinter (1914) provided a detailed portrayal of *C. carolo-schmidtii* Dinter. He described the leaves as channeled with a half-circle curved cross-section, with denticulate margins, and 500-600mm long by 7mm wide. Dinter remarked that bulbs bore scapes containing a single flower or occasionally two flowers, and that only one scape in a thousand held three flowers. He said this species was endemic in limestone vleis (temporary ponds) in Northeast Hereroland.

This species was misrepresented in previous studies. Sölch (1960) had difficulty in distinguishing the type from other herbarium materials, so he listed *C. carolo-schmidtii* as a dubious species. Verdoorn's (1972a, 1973a) confusion between *C. carolo-schmidtii* and *C. lugardiae* was discussed under the latter species. Roessler (1974) was misled by field photographs and dried mounts of bulbs growing in the vlei at Farm Wewelsburg; the latter species was *C. paludosum*, a larger bulb with broadly channeled leaves and umbels of 2-9 flowers.

The author's observations supported Dinter's account, except that this species was discovered growing in small vleis and in areas subjected to seasonal inundation in the flood plains of the Okavango and Zambesi Rivers. Collecting expeditions into Northeast Hereroland and Bushmanland never coincided with optimal rainfall—it was either too dry, or there was flooding which made travel impossible. Whenever this species was observed, it was a small statured plant with narrow U-shaped leaves that were usually less than 10mm wide, and with umbels bearing only 1-2 flowers. The leaves were sturdy, erect to suberect; the leaf arrangement matched the pattern displayed in Dinter's type specimen (***Dinter 2307***, holotype, B).

Once this species was found blooming in the absence of standing water in East Caprivi; its leaves were diminutive and sprawling

on the ground, 200-400mm long and 3-4mm wide. As such, these water-deprived bulbs exemplified the illegitimate *C. stenophyllum* Baker (1903b), non Baker (1881), reported from neighboring Angola adjacent to a tributary of the Okavango River. Baker apparently forgot that he previously had selected this epithet when naming a completely unrelated species from Burma belonging to *Crinum* subgenus *Crinum.*

15. *Crinum rautanenianum* Schinz, **Bull. Herb. Boissier** 4, App. III:48, 1896.
Syn.: *C. euchrophyllum* Verdoorn, **Flow. Pl. Afr.** 42:t.1642, 1972.

Districts sighted: **Ovamboland, Kavango, East Caprivi.**

During the rainy season this species flourishes and blooms in the temporary rivers of Ovamboland that flow south into Etosha Pan. The bulb is readily identified by its sturdy U-shaped leaves that are arranged in a distichous manner, and by its large white funnel-shaped flowers that turn deep rose as they decline.

Crinum rautanenianum also occurs within the flood plains of the Okavango and Zambesi Rivers and in swamps near Katima Mulilo in East Caprivi. Verdoorn (1972b, 1973a) received a living bulb collected near Katima Mulilo which she cultivated at Pretoria; having been reared in a small pot, the bulb was stunted. Verdoorn mistook the stunted bulb for a new species, *C. euchrophyllum* Verdoorn.

PROBABLE INDIGENOUS SPECIES REQUIRING FURTHER INVESTIGATION

1. *Crinum bulbispermum* (Burm.) Milne-Redhead and Schweickerdt, **J. Linn. Soc. Bot.** 52:149-162, 1939.

Crinum bulbispermum inhabits the flood plains of the Orange River in the Cape and Orange Free State Provinces of South Africa. No specimen of this species is known that unequivocally has been collected in Namibia adjacent to the Orange River or any of its Namibian tributaries. This is probably because of the rugged terrain which accompanies the Orange River as it courses along the southern border of Namibia. This region is populated sparsely and has limited access to the Orange River. There is one specimen (***Kraphol 4992***, PRE, n.v.) which was reported from Ariamsvlei in Namibia on the banks of the Orange River. Ariamsvlei is located in Namibia about 30km north of the Orange River, but Verdoorn (1973a) listed the actual collection site as falling within the Cape Province of South Africa.

2. *Crinum fimbriatulum* Baker, **J. Bot.** 16:196, 1878.

Crinum fimbriatulum is indigenous to West Angola. There is a specimen of *C. fimbriatulum* (***Leach 14510***, PRE, labeled as *C. kirkii* Baker) which was collected at Ruacana Falls on the Angolan side of the Cunene River; the plant was observed growing among rocks along the river's edge. Since the headwaters of the Cunene River reach into south central Angola, this solitary plant was likely a water borne representative. Two unsuccessful attempts were undertaken to locate this species in northwest Namibia (Kaokoland) in the extremely remote areas of the immediate flood plain of the Cunene River, beginning at Ruacana Falls and extending westward for a distance of approximately 50km. The possibility that isolated pockets of this species exist further west in Kaokoland along the Cunene River cannot be discounted.

EXCLUDED SPECIES:

1. *Ammocharis nerinoides* (Baker) Lehmiller, **Novon** 2:33-35, 1992.
Crinum nerinoides Baker, **Bull. Herb. Boissier** ser. 2, 3:666, 1903.

This small Namibian bulb was described originally only from herbarium materials. It was not until living plants were studied in the field that the definitive characteristics of *Ammocharis* were identified (Lehmiller, 1992d).

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1996 YELLOW CLIVIA REPORT

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Since my earlier article in the 1990 issue of **HERBERTIA** I have raised a large number of yellow clivias from various crosses and different sources. The commonest result has been that when yellow is crossed with yellow the offspring are 100% yellow. This is apparent as soon as the first leaf appears, as yellow clivias have clear green leaves and leaf bases with no reddish, purple, or even faint brownish pigment present.

This type of result has been obtained with various Japanese yellow strains, with the U.K. Kewensis strain, with yellows which appeared as seedlings amongst the generally orange Belgian strain (usually called "Belgian hybrids") and from crosses of all these yellows with various yellows grown in Australia. The origin of some of the Australian yellows is not known.

Even some yellow seeds obtained from different South African sources have produced 100% yellow offspring. Unfortunately, the origin of the parent plants of these yellows is not known. However, some South African yellow plants do not produce 100% yellow when either selfed or crossed with other yellows. As reported by Graham Duncan in the 1992 HERBERTIA, the plant called 'Kirstenbosch Yellow' produces 100% yellow offspring when selfed. Unfortunately I do not have this plant (I only have selfed seedlings) so I have been unable to cross it with other yellows that I have tested, to see if it produces 100% yellows when outcrossed, but I would expect it to. When I flower some of its seedlings I will cross them with other yellows and report whether my prediction is correct.

The main exceptions to all these yellow results has been the plant called 'Natal Yellow'. Graham Duncan, in his 1992 **HERBERTIA** article, reported that when selfed it produced 100% orange and when crossed with 'Kirstenbosch Yellow' it again produced 100% orange. These results are the same as one obtains with an orange clivia. That is, when selfed, one gets 100% orange offspring and when crossed with a yellow (a true breeding yellow) one gets 100% orange (the yellow is recessive). Thus 'Natal Yellow' is phenotypically yellow but genotypically orange. This means that, although it appears to be a yellow, it breeds as an orange.

Yellow clivias produce seed pods [fruits] which turn from green to a clear yellow as they mature, while orange clivias produce pods which turn from green to various shades of pink, red or purple-red. As yellow clivia seed is rare and valuable most growers have collected the seed pods of 'Natal Yellow' when they have turned yellow as the seed is quite fertile by that time (9-10 months after

flowering). However, *Clivia miniata* seed pods will remain on the plants for 14-15 months after flowering. Wessel Hotter in Pretoria has shown recently that the seed pods of 'Natal Yellow', if left on the plant longer (after turning yellow), eventually will turn a pale pink, indicating in this way that it is not a true yellow and can produce a small amount of red pigment which is absent from a true yellow.

The other exception, which has been raised in some quantity, is the yellow stain of Jim Holmes from Stellenbosch, South Africa. His strain originated with 'Karkloof Yellow' (self sterile) crossed with an unknown yellow. This originally produced a fairly high percentage of oranges as well as yellows (no figures available) but by crossing the yellow seedlings with each other, each generation has produced a higher percentage of yellows so that by the fourth generation the percentage is close to 100%. However, occasional oranges still occur.

The behaviour of this yellow strain suggests maternal (non-nuclear) inheritance rather than nuclear inheritance (chromosome mutation). My final conclusion, at this time, is that there are at least three distinct types of yellow clivias with different breeding behaviour.

1. The majority have a gene mutation within the nucleus (chromosomal) which behaves as a simple recessive (see my article in the 1990 **HERBERTIA**).

2. 'Natal Yellow' appears to be a somatic mutation rather than an inheritable mutation and is really a tinged yellow which breeds the same as an orange clivia.

3. Jim Holmes' strain may be a maternal or cytoplasmic mutation as selection has shown a steady increase in the percentage of yellow obtained from yellow x yellow crosses (but hasn't given 100% yellow regularly yet).

As there are still more wild collected yellows (apparently distinct from those above) which have not yet been tested for breeding behaviour, it is possible that other results may yet appear.

There are two widely spread myths about yellow clivias. The first is that one cannot reliably raise yellow clivias from seed. My results have shown that in the great majority of cases if one crosses yellow with yellow then the seedlings are 100% yellow. However, controlled hand pollination is required to ensure that no orange pollen has pollinated the yellow by chance. As yellows are rare, there are usually many more oranges around to pollinate the yellow flowers. Also, most yellows are either self-sterile or produce few seeds per pod when self pollinated. Therefore, in most cases where yellows set seeds without assistance, it usually has been

with orange pollen and the offspring will be orange. When two different clones of yellow are crossed by hand pollination, many seeds per pod are obtained. My average is six seeds per pod with a maximum of fifteen.

The second myth is that seed from a yellow seed pod will produce yellow seedlings. This is quite incorrect as the yellow seed pod simply tells us that the mother plant is a yellow. It tells us nothing about the offspring. If the mother plant was pollinated by pollen from orange flowers the seed pods will be yellow but the seedlings will be orange. If it was pollinated by a pollen from a yellow flowered plant the seed pods will be yellow and the seedlings will be yellow (except for the cases discussed earlier, *e.g.* 'Natal Yellow').

This article has reported the main conclusions of my yellow clivia breeding. However, I have not discussed the marked improvements I have obtained in size of flowers, shape and vigour. I will save these for a future article.

1995 flowering of yellow clivia seedling 95/1. Flowers were 100mm (4 inches) across.

Photo: William Morris

THE HABITAT OF *HAEMANTHUS PAUCULIFOLIUS*, A NEWLY DESCRIBED SPECIES FROM SOUTH AFRICA

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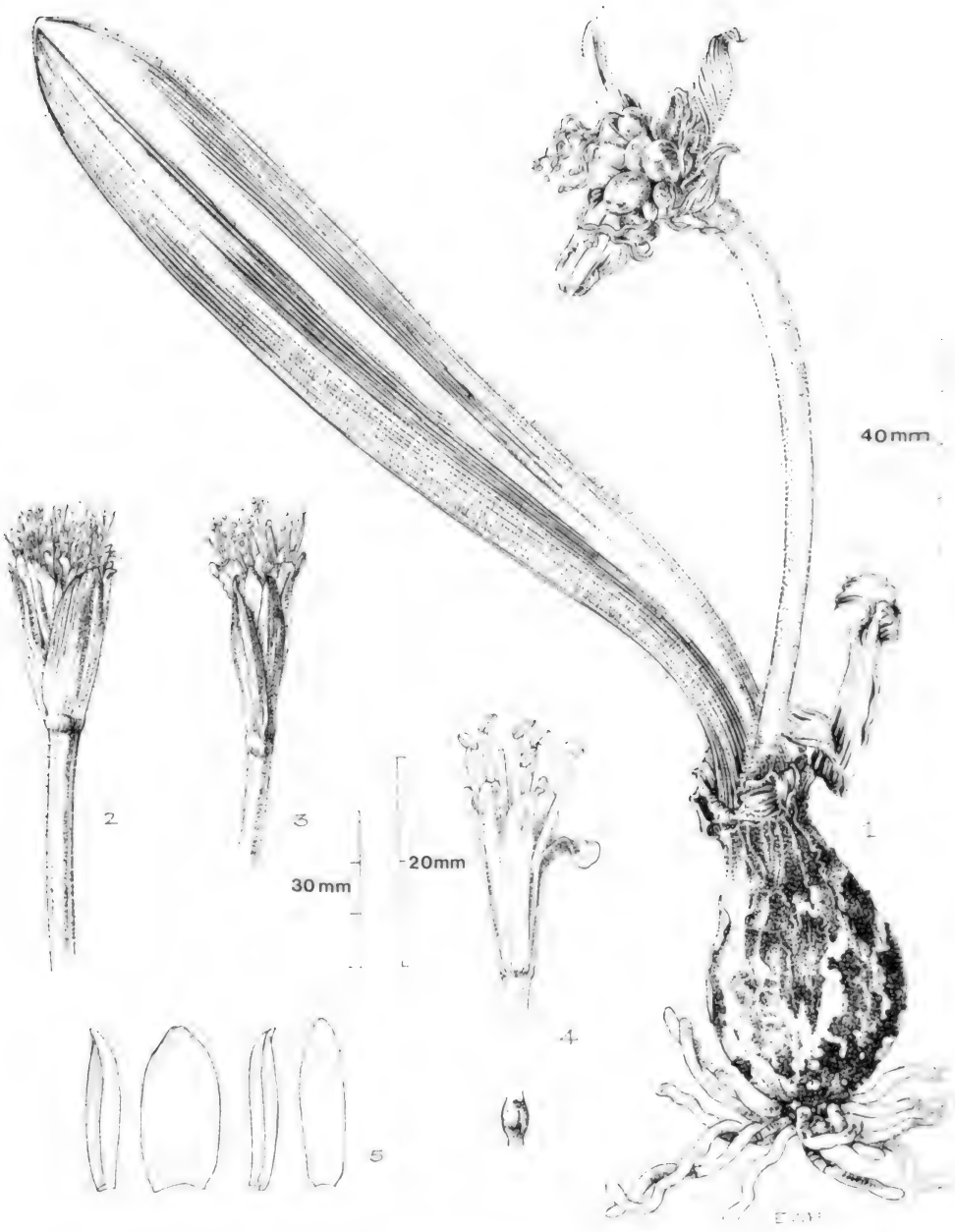
Haemanthus pauculifolius was described in the **South African Journal of Botany** in 1993, after the publication of **The Genus Haemanthus: A Revision** (Snijman 1984). At the time of going to press the new species was known from a few remote forested areas in Mpumalanga near Barberton and Komatipoort, as well as the Blyderevierspoort Nature Reserve.

Haemanthus pauculifolius is part of a closely related group including *H. albiflos* and *H. deformis*. It has, generally, one long solitary leaf and grows partly exposed above dense pads of forest humus, often on cliff ledges.

A colony near Louws Creek in Mpumalanga was examined in January 1997 with a view to learning more about the rather specific niche of this species in its woodland habitat. The colony concerned comprised many thousands of plants densely packed onto cliff ledges and very steep banks of south-facing cliffs covered in thick forest vegetation. Groups of plants grew in pads of humus-rich light soil in full shade or in lightly dappled shade. The south-facing positions occupied by the plants allow them to receive some morning sunlight in summer until about midday. In the winter months the plants are in shade all day except for a few hours after sunrise. About 40 groups of plants were investigated comprising about 20 to several thousand individuals.

In most instances the bulbs occupied entire cliff ledges. This "crowding" habit is probably unique in the genus. When groups of bulbs outgrow their cliff ledge habitat, clusters of about ten to a few hundred bulbs drop off the ledges, either landing on cliff ledges lower down, or other vacant humus-rich niches. Occasionally clusters of bulbs lodge in the forks of large trees where, in time, they attract accumulations of humus. This clustering habit ensures that every possible cliff ledge and related niche in the environment is populated by *H. pauculifolius* bulbs. The bulbs tend to fall off in clumps rather than individually, rendering them heavier and less likely to bounce off unpopulated ledges when they fall.

The plants are winter flowering, seeding in spring before the summer rains begin. A large amount of seed is available for germination in the humus pads before the rains fall, which would wash the seeds away. Seeds either germinate around the parent bulbs or drop onto humus-rich ledges lower down. In addition to copious seed production, most bulbs multiply from the base.



Haemanthus pauculifolius. Illustration by Ellaphie Ward-Hillhorst, originally published in the **South African Journal of Botany**, volume 59, part 2, pages 247-250. Reproduced by kind favour of Prof. J.N. Eloff, Scientific Editor.

Despite the abundance of the species where found, its niche is very specific. It occurs on humus-rich cliff ledges or steep banks, well screened by forest trees and bush. It avoids higher rock ledges on the exposed cliffs near the mountain summits. It is also absent from the more arid sunny east-facing cliffs and rocky slopes. The east-facing cliffs are home to a most unusual undescribed *Ledebouria* species of cracks in vertical cliffs. Most of these bulbs grow downwards, parallel to the cliffs.

Taxonomists are often interested in physical and chemotaxonomic differences between plant species when engaged in species delineation. However, the more dimensions considered, the more likely the taxonomy is to be sound. The ecology and habit of various genera in the Amaryllidaceae is a case in point.

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CRINUM ACAULE IN ZULULAND, SOUTH AFRICA

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Crinum acaule is one of South Africa's most beautiful and spectacular amaryllids. The flowers are strongly scented in the late afternoon, at dusk and at night, and slightly less so during the day.

In Zululand this species has been recorded from the Makatini Flats and the Ndumu Game Reserve in the north, and the sandy grassy areas around Lake St. Lucia in the south. Its distribution does not appear to extend much further south than the southern boundary of the Greater St. Lucia Wetland Park (GSWP)(Fig. 1).

It was decided to conduct a preliminary survey of *C. acaule* during the flowering and fruiting season in the spring and summer of 1996 (early October to December). Plants are observed easily, being conspicuous when in flower. October is usually the peak of the flowering season. Research was conducted in regions heavily forested with exotic timber west of the GSWP, as well as in the GSWP. The approximate locations of these *C. acaule* colonies are given in Figure 1. The former area is controlled by the South African Forestry Company Limited (SAFCOL), one of South Africa's largest timber companies, and the latter, one of South Africa's best known reserves, is controlled by the Natal Parks Board. Access to both these areas is controlled by SAFCOL and the Natal Parks Board, respectively.

The northern part of Zululand is densely settled with scattered homesteads and afforested with exotics along some of the coastal strip. Much of the habitat is severely overgrazed and degraded and ground cover such as grass, depleted. Some large local populations of scarce endemic plants are declining rapidly or are locally extinct, such as *Brachystelma tenue* and *B. vahrmeijeri*. Plant species compatible with regular burning and/or heavy grazing either exist in stable or expanding populations such as *Crinum delagoense*. Degraded areas usually are recognised by dense stands of *Helychrisum kraussii*.

No populations of *Crinum acaule* were found during a brief survey of the northeastern section of the Makatini Flats, in suitable habitat. (The species may never have been well represented in this area.) Further work is required, particularly in protected reserves, to ascertain the numerical strength of the populations.

HABITAT ON SAFCOL-CONTROLLED PROPERTY

Crinum acaule is largely restricted to road sides and fire-breaks on SAFCOL controlled property. These reserves fringe extensive

Crinum acaule. Water colour painting by Gillian Condy of a plant in fruit, flower and bud in the last few days of October 1996. The plant was growing east of Matutatuba on a regularly mowed fire-break at the side of an exotic eucalyptus plantation. The flowers in the foreground opened in the late afternoon and evening. The two buds in the background opened at the same time a few days later.

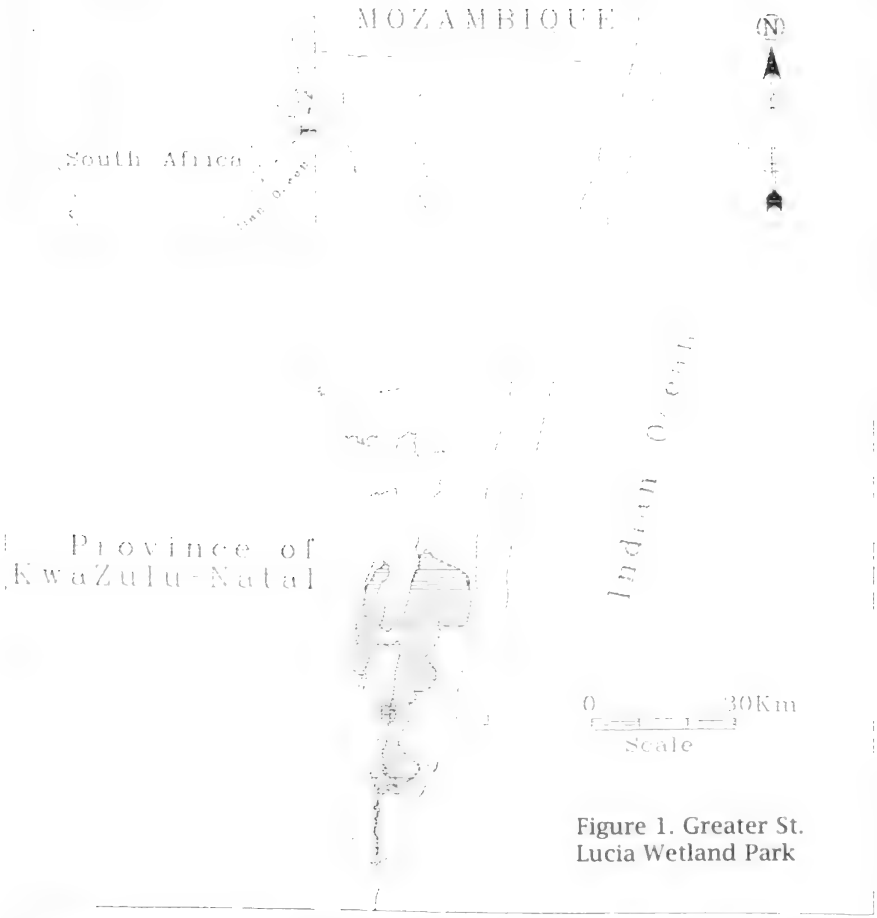


Figure 1. Greater St. Lucia Wetland Park

plantations of eucalyptus and pines. The territory comprises undulating sandy grassland and groups of *C. acaule* number about 5-80 or more plants.

The grassland on the fire-breaks is regularly mowed in order to comply with plantation insurance requirements. It is also ploughed up periodically (rotovated). This disturbed habitat is rapidly colonised by weeds such as the alien *Chromolaena odorata* (Blackmore, s.n.). The twin processes of mowing and rotovating have most interesting affects on *C. acaule* populations, clearly leading to increases in overall population sizes. This is discussed in more detail below.

Crinum acaule survives in plantations but does not appear to flower and reproduce. The populations rarely flower in newly afforested areas, where the trees are still young, since the habitat is extensively cluttered with tall dead grass and herbage. Populations frequently were found where plants were in full flower on the road reserves, yet populations in neighbouring young pine plantations had produced only leaves.

Like so many other crinums, *C. acaule* is a species which occurs naturally in groups of plants comprising varying ages. These consist of mature bulbs and their offspring of various sized bulbs which have become established after good seed sets over the years. Some groups of *C. acaule* conformed to this pattern, whilst others could be better classed as road reserve populations occurring in uninterrupted groups of 50 plants or more.

THE FLOWERING AND FRUITING PROCESS

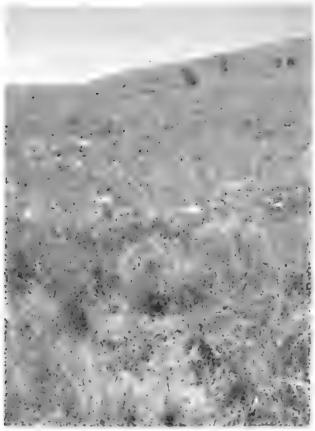
Crinum acaule is one of the earliest species to flower in the summer rainfall area of South Africa, probably as flowering is not dependent on spring rains. The flowering season begins in early September and ends in early November with a peak in October, usually the first two weeks of that month. The first summer rains may fall in October, but November is more usual.

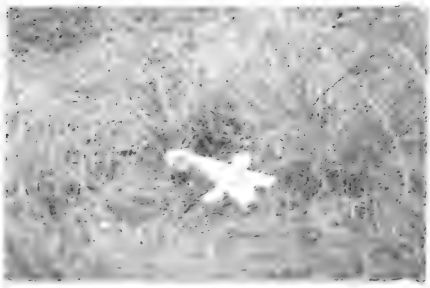
Populations examined near Matubatuba in early October 1996 were all in full flower. Some plants already had flowered and had well formed seed at that time. This may be attributable to heavy rain which fell in the late winter and improved the soil conditions conducive to an early growth cycle for the crinums.

Once pollinated, *C. acaule* seeds develop quickly, usually taking only about four weeks. This is significant since seed set early avoids destruction by the Amaryllis Caterpillar (*Brithys trinii* subsp. *pancratii* Cyrillo 1787). The caterpillars are very destructive to *C. acaule* stems, flowers, seeds and leaves, mainly during November.

Like many amaryllids, *C. acaule* requires an open and uncluttered habitat to flower, set seed and produce young bulbs. Wherever ground had been mowed or rotovated in the road reserves, an estimated 30–50% of given populations were in flower. (Bulbs not in flower were either too young or had skipped a season, which happens with most South African *Crinum* species.)

Crinum acaule is one of three species with strongly scented flowers, *C. foetidum* and *C. minimum* being the other two. *Crinum acaule* flowers are particularly strongly scented at dusk and at night whereas those of *C. foetidum* and *C. minimum* are strongly scented by day and night. The evening scent of *C. acaule* would seem to suggest a nocturnal pollinating agent such as a hawk moth species. This may be so, but several insects are probably responsible for

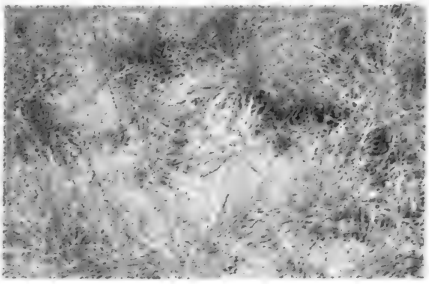




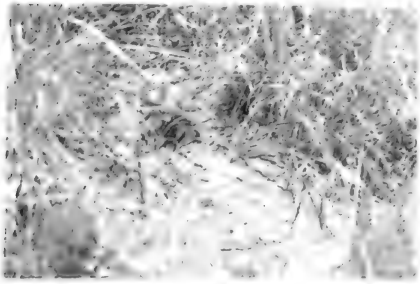
B. *Crinum acaule* flowering on the Western Shores of GSWP. This grassland is slightly encroached with woody plants and, consequently, the grass cover is less dense than that observed around the Eastern Shores.

▲ A. Typical coastal grassland *Crinum acaule* habitat on the Eastern Shores of the Greater St. Lucia Wetland Park, adjacent to a warthog burrow.

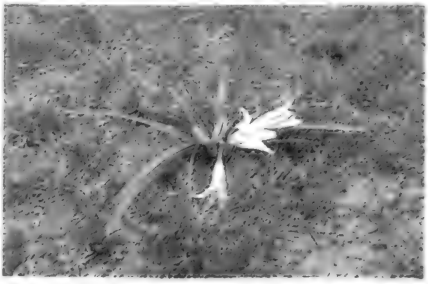
C. *Crinum acaule* flowering on a rotovated fire-break along the Greater St. Lucia Wetland Park/SAFCOL property boundary.



D. *Crinum acaule* fruiting on a disused warthog burrow on the eastern shores of the Greater St. Lucia Wetland Park.



E. Moribund grass layer was opened up to reveal a *Crinum acaule* plant.



F. *Crinum acaule* flowering on a regularly mowed SAFCOL fire-break.

All photographs by Andrew Blackmore, taken in late October, 1996.

pollination; flowers were always full of beetles and bees, as well as butterflies and moths. The flowers produce particularly copious amounts of pollen.

The 1996 flowering season in the SAFCOL colonies was a good one, but the seed set surprisingly poorly. Less than an estimated 20% of plants formed seeds, some of which aborted before ripening. Nearly all the seed was eaten by Amaryllis Caterpillars. The same situation was observed at colonies in the GSWP. Seed destruction by the caterpillars is a cyclical process with infestations very bad in some years and slight or non-existent in others. October and November 1996 were characterised by severe infestations on most *Crinum* species in Kwazulu/Natal.

THE ECOLOGY ON THE SAFCOL ROAD RESERVES

Perhaps the most interesting finding during the research was that SAFCOL's management of its road reserves led to an overall increase in *C. acaule* numbers. Mowing and rotovating the road reserves creates the ideal conditions for *C. acaule* flowering, since the habitat is always clear of grass clutter, such condition being required by this species for mass flowering. Rotovating, which is not nearly so frequent as mowing, does not damage the *C. acaule* populations unless it takes place at flowering or within about 3–4 months afterwards.

The ploughing has the effect of burying bulbs more deeply in the sand, with the consequence that in subsequent years they are too deeply buried to be damaged. Some large shallow bulbs do get damaged; the sides of the bulbs get sliced or their necks truncated. Their response to this is to proliferate bulblets around the damaged areas. Specimens examined where this had occurred had produced from 2–20 bulblets.

Should mowing take place at flowering time an entire crop of flowers and potential seeds would be destroyed. Fresh seeds must, like all *Crinum* seed, germinate at ground level. Seed takes between three weeks and three months to germinate and the soil needs to be undisturbed during this period.

Rotovating road reserves has an interesting effect on plant species. Generally bulbs and caudiciforms deep in the soil are little affected. More shallow species such as *Pelargonium luridum* are broken up with the result that the populations proliferate from the new sections of tubers. Bulbous plants with perennial foliage tend to disappear from the road reserves, particularly two spectacular species, *Dierama sertum* and *Kniphofia littoralis*, which are represented in open grassland adjacent to SAFCOL's plantations.

BURNING OF GRASSLAND AROUND THE EXOTIC FORESTS

SAFCOL regularly burns coastal grassland under its auspices that are not forested with exotic timber. A section of this grassland is located east of the Makakatana Forest Station close to a large population of *C. acaule*. This area was examined four times during October and November 1966, after the area had been burnt. Bulbous and cormous plants, requiring clearing of the habitat and/or burning of the grassland to flower, bloomed particularly well. *Kniphofia littoralis* and *Dierama sertum* populations produced abundant flowers followed by good seed set. The short grassland promoted ideal germination conditions. Both of these species develop quickly and some young plants would be capable of surviving another fire when the grass is dry the next winter.

STUDIES IN THE GREATER ST. LUCIA WETLAND PARK

Studies were also conducted in the GSWP. The data collected (Table 1) and what follows is a discussion of the research findings.

Most populations of *C. acaule* were small, numbering between 5 and 11 plants. Colonies were located in sandy grassland on very well drained soils as with the populations on SAFCOL property. The natural habitat was interspersed with occasional shrubs and contained open clearings in the grass around warthog burrows, rotovated firebreaks or game paths (Photos A-F).

Plants flowered where the habitat was open and uncluttered with moribund grass, very much the same pattern as in the exotic timber areas under SAFCOL's control. The numbers of plants flowering in individual populations were similar to those observed in flower on SAFCOL property. This suggests that in any given habitat less than half the population may flower in a given season, irrespective of whether or not the habitat is sufficiently clear to initiate flowering.

Few plants were observed in fruit which again parallels the situation found on SAFCOL property. Seeds were eaten by beetles and negligible amounts were available for germination; flowers were also destroyed, the same as occurred on SAFCOL property. Beetles may play a significant role in the destruction of seed either together with the Amaryllis Caterpillar, or separately, in different seasons. This information needs to be investigated further.

GERMINATION AND DEVELOPMENT OF SEEDS

Crinum acaule produces some of the largest seeds in the genus in South Africa, about the same size as those of *C. foetidum* which has similar methods of seed dispersal. Each beaked fruit usually produces 1-3 seeds, generally of quite variable size. In years when the rains fall late, seeds are fully formed and liberated into the

environment before the first rains. The large heavy seeds generally fall around the parent bulb where they germinate. This seed distribution pattern gives rise to the characteristic small groups and scattered sparse clumps so typical of *C. acaule.*

Seeds produce a radicle 3-8 weeks after liberation from the fruit. The large seed nourishes the bulb forming below the ground for the duration of the current summer and this sometimes extends into the following season. This characteristic is shared with *C. foetidum* which has almost identical large papillose seeds. All the other South African *Crinum* species with smooth seeds usually have exhausted the food supplies in the seed after 8–15 weeks and the dry seed remains decompose or blow away.

Young bulbs are elongated and thin, a characteristic shared by most other *Crinum* species. Bulbs start to thicken at the base after a few years as they mature.

MANAGEMENT OF POPULATIONS IN THE MODERN ENVIRONMENT

The future of *C. acaule* is assured as long as the Greater St. Lucia Wetland Park remains. Populations of the species on SAFCOL property appear to be stable and have probably increased on the road reserves since conditions for flowering in these situations are always suitable. If mowing of the grass can be restricted to autumn and winter, ideal conditions for the flowering, seeding and germination of the plants will be created. Though ploughing the road reserves has little effect on deep, mature *C. acaule* bulbs, seedlings and germinating seeds would be destroyed.

The view could be taken that *C. acaule* populations on road reserves are not natural and consequently not particularly important. During the survey outside the St. Lucia Reserve, the only significant numbers found were all on SAFCOL road reserves. They, therefore, represent important populations in the modern environment outside the St. Lucia Reserve.

The status of *C. acaule* on the Makatini Flats is not clear, but the habitat is being settled and degraded rapidly with the consequence that little suitable habitat for the existence of *C. acaule* will remain in future years. Seed from these populations could be used to propagate plants in nurseries, with a view to populating other areas and stocking indigenous nurseries with these plants.

HORTICULTURAL POTENTIAL

Crinum acaule is one of the most attractive species found in South Africa and, along with *C. foetidum* and *C. minimum*, is one of only three species that have strongly scented flowers. Plants can be grown readily and quickly from seed and the young bulbs are

not so prone to fungal attack as some species, such as *C. buphanoides*. The main limiting factor at present is the paucity of seed. Experiments are currently under way to see if *C. acaule* can be tissue cultured from seed stock. Seed could become more readily available if a joint programme for seed harvesting under certain environmental conditions could be established with SAFCOL.

ACKNOWLEDGEMENTS

We thank Mr. Gerrit Kruger of SAFCOL for issuing a permit for the research into *C. acaule* populations on SAFCOL property, and Gillian Condy of the National Botanical Institute, Pretoria, for setting aside the time to travel to Zululand to prepare the water colour plate of *C. acaule* flowering in habitat.

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Table 1. Data collected from the Greater St. Lucia Wetland Park (GSWP)

Location	Estimate of population size	Area (m^2)	No. of plants	% of plants in flower	No. of plants set seed	% of plants set seed	No. of seeds	% of seeds	Percentage of total
Eastern Shores	5	0.6	0	0	0	0	0	0	0
Eastern Shores	9	0.05	3	33	2	22	0	0	0*
Eastern Shores	7	0.3	2	29	1	14	0	0	0**
Western Shores	11	0.5	4	36	2	18	1	9	1***
Western Shores	1	0.02	0	0	0	0	0	0	0

* flower damaged or eaten, fruit eaten
** seed eaten
*** two removed for herbarium collection; 1 fruit eaten

EFFECTS OF TEMPERATURE ON GROWTH AND DEVELOPMENT OF *IXIOLIRION TATARICUM*

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Since Traub (1942) stated that Florida winter temperatures are insufficient to allow normal development of *Ixiolirion*, but two month's treatment in a refrigerator caused normal flowering, no further investigation on temperature effects on growth and flowering have, to our knowledge, been conducted. Some years ago, therefore, we started a series of experiments to learn something about temperature effects on growth and development of this plant

The survival organ is a tunicated corm (Dahlgren *et al.*, 1985) which can be harvested under our conditions (52° northern latitude) in July. At the base of the egg-shaped corm a renewal bud can be found after removing the chocolate-brown, leathery tunica. This corm develops from the thickened first stem node of the plant. Sometimes the corm includes parts of the second node. The bud, about 1.2± 0.2mm in length, consists of a meristem and 1-3 leaf primordia (Fig. 1). Experiments with corms in this stage of development (Zimmer 1991) may be summarized as follows:

During a 16 week period of dry storage at different temperatures, renewal buds elongated to a very distinct extent (Fig. 2). While a storage temperature of 2°C caused growth of the buds to be nearly inhibited, elongation was promoted to the highest extent at a dry storage temperature of 10°C. Microtome sections every two weeks revealed that differentiation of leaves, inflorescences and root primordia was highly affected by storage temperatures. At 2°C, even after 16 weeks, no further differentiation of leaves was detectable and no root primordia were found. At 10°C, however, up to 7 leaves were produced, and after 6-8 weeks of storage inflorescences became visible (Fig. 3). At 17°C up to 11 leaves were formed and inflorescences became visible after 8 weeks. Length of renewal buds at this stage of development (after eight weeks dry storage at 10° or 17°C) was about 14mm. At 25°C during dry storage, differentiation processes were inhibited, although after 14 weeks flower primordia were produced (Fig. 4).

During the period of dry storage, growth of the corm for the next period is initiated as well as the formation of the renewal bud for the period after next (Fig. 5). The basal part of the stem is thickening and in the axil of the leaf sheath the renewal bud is found.

Results of mictotome sections indicate that dry-warm summer conditions at the natural habitat do not prevent differentiation of leaves, inflorescences and root primordia but indeed delay these

processes until autumn, while very low temperatures inhibit differentiation completely. Earliest flower formation was found at 10° or 17°C, respectively, but highest rate of elongation was obtained at 10°C. This lower temperature seems to fulfill part of the suggested low temperature requirement for elongation. This can be seen from results of an experiment with corms which were stored for 16 weeks at 2°, 10°, 17° and 25°C, respectively, and then planted at different night temperatures (Fig. 6). Corms stored at 10°C grew out 25-30 days after planting, independent from planting temperature. Corms stored at higher or lower temperatures required 50-90 days depending on planting night temperature.

Commercially stored corms (unknown conditions) planted at different temperatures demonstrated the low temperature requirement very clearly: although the root growth at the base of the renewal shoot was promoted at 11° or 14°C, elongation rate of the shoots was nearly the same at all planting temperatures during a 20 week period after planting (table 1, fig. 7). After this initial 20 week period, however, elongation rate changed drastically at 14°, 11°, 8° and 5°C, but not at 17‡C. These results indicate that even 5°C is not a limiting temperature for elongation of the fully differentiated plant. On the other hand, 17°C allows differentiation but does not fulfill the low temperature requirement for elongation growth. In this experiment the corms were rooted. In another experiment the corms were stored dry at 5-6°C for about six months. During this time they developed renewal shoots of 3-5cm in length including all organs for the next plant. The shoots stopped growth until planting and rooting. After planting they rooted immediately and flowered 50 days later at day/night temperatures of 20°/17°C (Zimmer 1987, Zimmer and Nink 1987).

The life cycle of the plant under natural conditions may be described in the following way: under dry-warm summer conditions differentiation of the new plant is initiated, but retarded. With rainfall in autumn and lower temperatures differentiation of leaves and flowers is enhanced and rooting is promoted. Corm and renewal buds for the next growing season are already initiated. Low winter temperatures saturate the low temperature requirement. Elongation can start with temperatures of 5°C and the plant will develop during spring. With increasing elongation of the shoot, leaves produce assimilates enough not only for further development of shoot and flowers but for the growth of the new corm at the base of the stem as well. After flowering, leaves and stem dry off and the remaining corm may start a new cycle.

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Table 1. Effect of temperature on root growth of *Ixiolirion tataricum*. Average of samples (n=20) after 6 and 8 weeks (after Zimmer & Nink 1987a).

Temperature (°C)	Length of roots (mm)	Dry matter (mg)
5	3.9	2.4
8	5.9	2.1
11	35.8	13.7
14	14.1	8.0
17	2.3	1.1
HSD 5% level	4.7	4.3

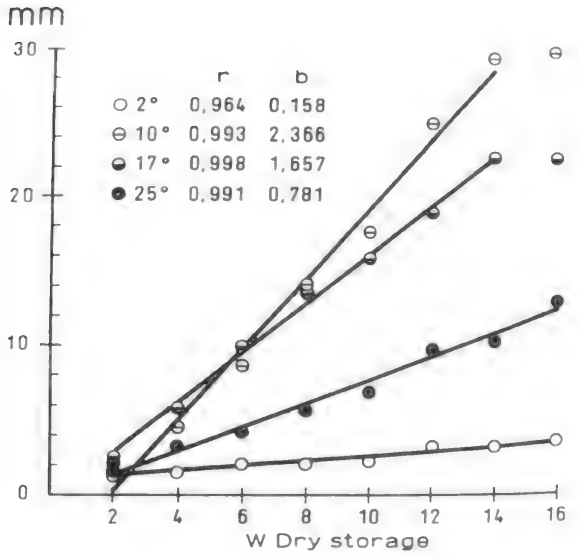

Figure 2. Elongation growth of buds during dry storage at different temperatures.

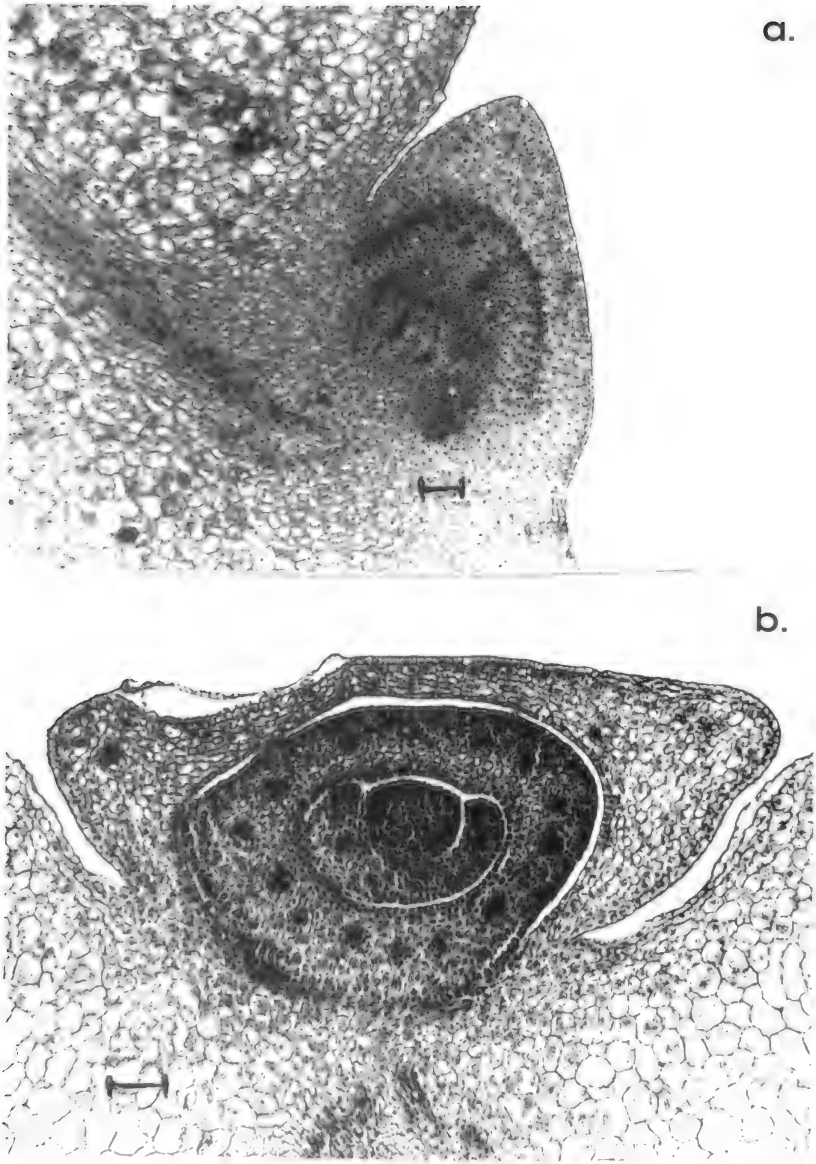

Figure 1. Renewal bud at the beginning of dry storage (August 11)
a. longitudinal section with vascular tissue and parenchyma of corm.
b. cross section. Horizontal bars: 0.1mm.

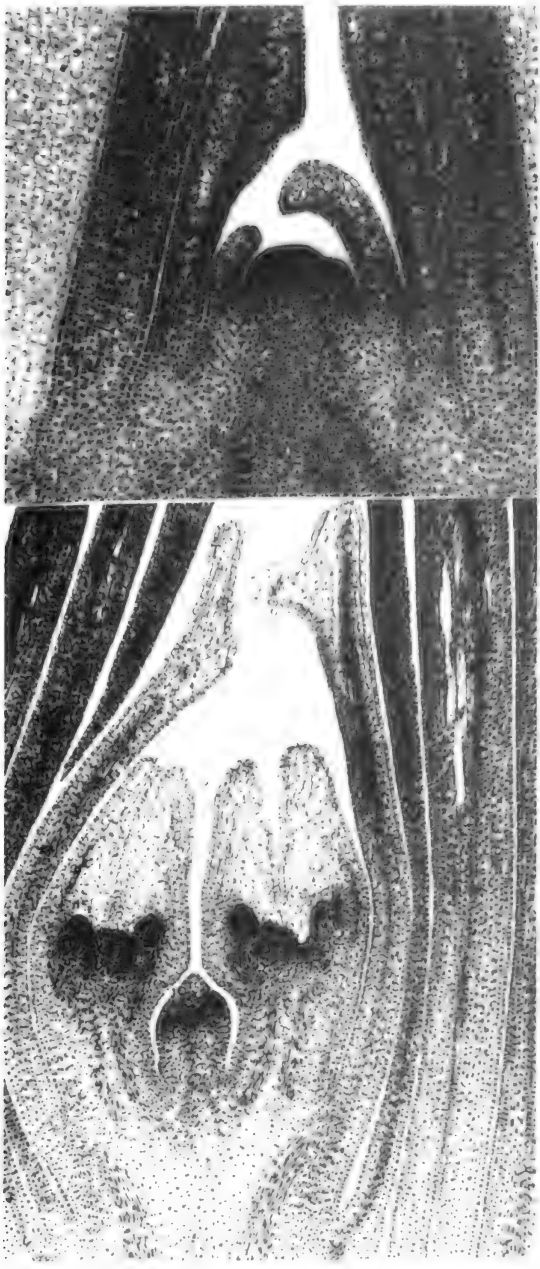

Figure 3. Stages of flower differentiation.
a. above: apex after 6 weeks at 10°C.
b. below: flower primordia after 10 weeks at 10°C.

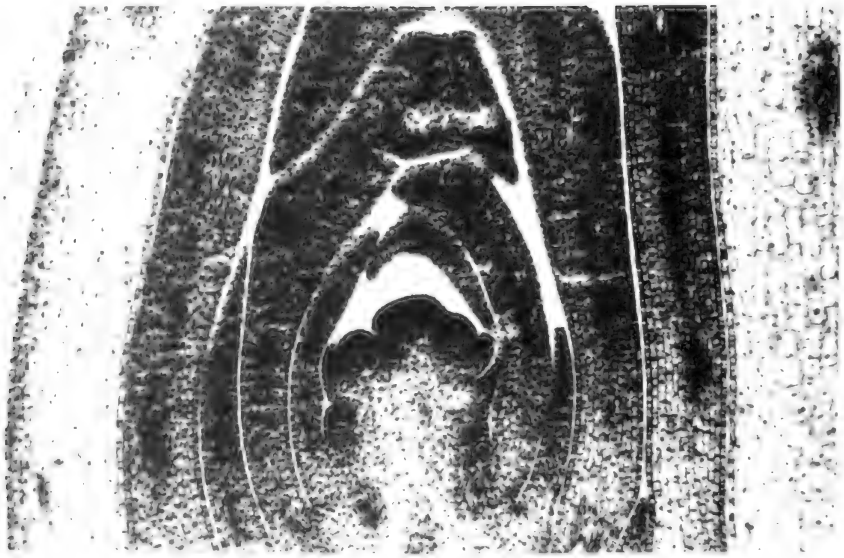

Figure 4. Flower primordia after 14 weeks at 25 C.

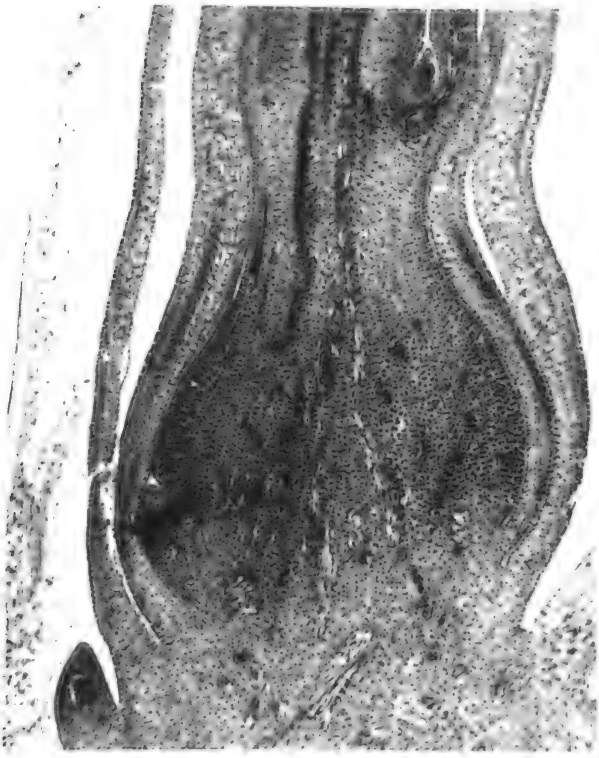

Figure 5. Basal part of the renewal shoot after 14 weeks at 10°C: beginning of thickening (corm formation) and renewal bud for the growing period after next.

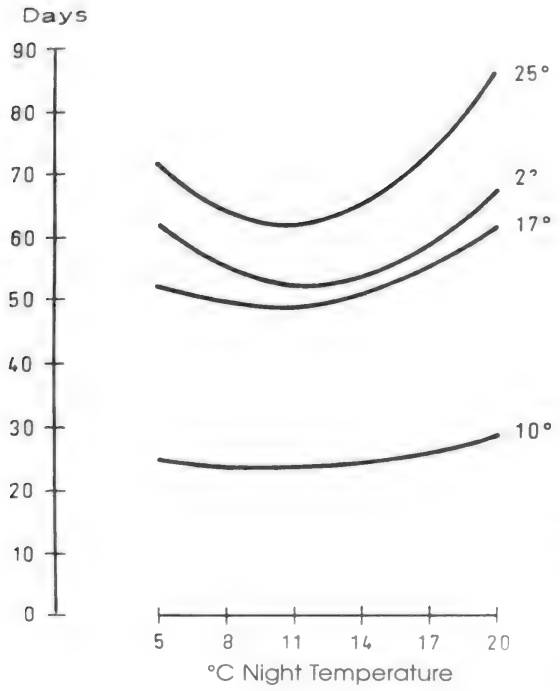

Figure 6. Effect of night temperature after planting (16 hours per night) on days to visible sprouts of corms stored dry for 16 weeks at 2°, 10°, 17° and 25°C.

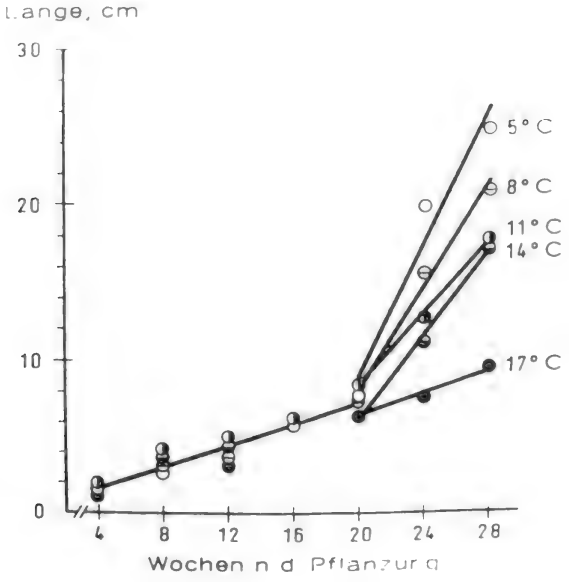

Figure 7. Shoot growth of commercially stored corms after planting at different temperatures.

NERINES IN SOUTH AFRICA

Rachel Saunders

The Latin name *Nerine* is from the Greek *Nereis*, the name of a sea-nymph. The genus is endemic to Southern Africa and the species are widely distributed throughout the region with the largest number in the summer rainfall areas. Most species grow in large colonies in the grassland, and they may be evergreen or deciduous. If deciduous, they may be either winter or summer growing.

Nerine sarniensis, probably the best known member of the genus, has been cultivated in Europe since the early 17th century and, together with *Nerine bowdenii*, has been used extensively in breeding programmes resulting in many of the hybrids we have today.

The taxonomy of the genus *Nerine* is in great need of revision. In 1967 Hamilton Traub published "Review of the Genus *Nerine*" in PLANT LIFE 23(2):3-32. In this publication he recognised 30 species. In a recent article (NOVON 5:103, 1995), Dierdré Snijman states that there are approximately 22 species, so presumably several of Traub's species have been reduced to synonymy. She then went on to describe a new species found in the Karoo, so the number increases again to 23. This agrees with the list of *Nerine* species published in Plants of Southern Africa: Names and Distribution edited by T. Arnold and B. de Wet (1993). However, not everyone agrees that synonymous species are actually the same, resulting in a fair amount of confusion in the genus!

Below are the species as listed by Arnold and de Wet, plus information on the growth characteristics of the plants, obtained from a variety of sources.

Nerine angustifolia: from the southeast Transvaal and Swaziland; evergreen; leaves to 60cm, pink flowers on inflorescences to 1m tall, pedicels very hairy.

Nerine appendiculata: from Natal and the Eastern Cape in damp areas; evergreen but may abe deciduous; summer growing; flowers in late summer or autumn are pale to deep rose-pink.

Nerine bowdenii: from the Eastern Cape and Natal; deciduous, summer growing; 20-30cm long leaves; hysteranthous, 30-70cm flower spikes, flowers rose-pink or white.

Nerine filifolia: from the Eastern Cape, Transkei, Orange Free State, Swaziland and Mpumalanga between rock slabs or in shallow soil over rock; almost evergreen (summer growing); filiform (thread-like) leaves; flower inflorescences to 50cm tall in April [in South Africa]; flowers bright mauve-pink or white.

Nerine frithii: from the Transvaal, Orange Free State and Eastern

Cape; deciduous? or evergreen, but probably deciduous and summer growing; flaccid filiform leaves to 15cm, pink widely spreading flowers with undulate margins.

Nerine gaberonensis: from southeast Botswana, northwest Transvaal and the northern Cape; deciduous, summer growing; a dwarf species growing to 25cm tall; pink flowers.

Nerine gibsonii: from the Eastern Cape and Transkei at an altitude of 1,500-1,700m in grassland; more or less evergreen (dying back briefly in mid-winter); filiform leaves, umbels have 4-9 flowers, perianth segments have slightly undulate margins, flowers are glittering white suffused with pale pink at the apices with a pinkish stripe to purple with all shades of pink in between.

Nerine gracilis: from the Transvaal; deciduous? or evergreen, but looking at its distribution, it is probably deciduous and is summer growing; filiform leaves to 30cm, small flowers on 20cm peduncle, plant is small and looks similar to a *Hessea*.

Nerine hesseoides: from the Orange Free State; deciduous? or evergreen, probably deciduous, summer growing; glabrous flat leaves, small pink flowers with undulate margins.

Nerine humilis: from the southwest and southern Cape; deciduous, winter growing; leaves to 30cm long, hysteranthous, pale to deep pink flowers with red central stripe, flowering in autumn.

Nerine huttoniae: from the Eastern Cape; deciduous, summer growing; prostrate leaves, flowers in summer, large pinkish-maroon flowers.

Nerine krigei: from the southeast Transvaal and northeast Orange Free State; deciduous, summer growing; leaves spirally twisted, inflorescences to 60cm tall, flowers large and pink.

Nerine laticoma: from the northern Cape, Namibia, western Transvaal, Orange Free State and Botswana; deciduous, summer growing; prostrate leaves, inflorescences 15-30cm tall with large pink or white flowers.

Nerine marincowitzii: from the Karoo; deciduous, summer growing; somewhat succulent leaves to 30cm, pink flowers aging to brown, no scent; flowers in autumn so is hysteranthous; when dry, the scape breaks off at ground level and the whole structure tumbles in the wind (like *Brunsvigia, Boophane*, etc.).

Nerine masonorum; from the Transkei; evergreen; a dwarf species to 25cm tall, grass-like leaves, pale to deep rose-pink flowers with central darker stripe in summer; bulbs multiply profusely.

Nerine pancratioides: from Natal; deciduous? or evergreen, but comes from a summer rainfall area; bright green leaves to 30cm, white flowers.

*Nerine ...continued on page...*186

CRINUM ACAULE, C. MINIMUM AND *C. PARVIBULBOSUM* IN SOUTHERN AFRICA

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Charles Craib asked me to review the taxonomic position of the little known *Crinum acaule* and *Crinum minimum* to accompany his two papers. *Crinum acaule* and *C. minimum* are arguably among southern Africa's most spectacular bulbous plants. It is especially odd that so little is known about their taxonomy and horticulture. Since Verdoorn (1969, 1973) wrote on the plants, little additional information and only a few additional specimens have been collected up to now. Incidentally Baker (1897) described *C. acaule* 100 years ago in the addendum to **Flora Capensis**. It is hoped that Charles' papers, accompanied by Gill Condy's excellent plates will lead to the successful cultivation and more complete knowledge of these species.

In southern Africa there are three taxa of small, few-flowered *Crinum* with a funnel- to bell-shaped, red-keeled corolla. Nordal (1979) briefly reviewed these, with two others from central Africa when proposing a name for a new Kenyan species. While there is little doubt that the species are closely related, they are distinct taxa occupying divergent habitats. *Crinum acaule* is the most robust species, endemic to Zululand. It can be distinguished from *C. minimum* by its broader, ciliated leaves, larger bulb and larger flowers with petals thick and fleshy. Its peduncle is below ground while that of *C. minimum* is usually above ground. *Crinum minimum* is widespread in southern and eastern Africa, and is remarkably constant over its range, with leaves narrow and involute. *Crinum parvibulbosum*, which was sunk under *C. minimum* by Verdoorn (1969, 1973) seems to be sufficiently distinct to be maintained provisionally as a separate species. This species is distinctly more broad-leaved than *C. minimum* and has broader perianth segments. It is distinguished from *C. acaule* by the aerial peduncle and smaller dimensions.

The distribution map (Fig. 1), has been prepared from specimens in the National Herbarium (PRE) only. The distribution of the species is expected to expand considerably if data of more herbaria are included, especially in Mozambique.

Crinum acaule Baker in **Flora Capensis** 6:532 (1897); Uphof in **Herbertia** 9:82 (1942); Verdoorn in **Bothalia** 11:39 (1973); Nordal in **Norw. J. Bot**. 26:151 (1979). Type: Zululand, Sambaans territory, ***Saunders s.n.*** (K, holo.).

Bulb 70–120mm long, 50–150mm diameter, forming a neck 4–100mm long. Leaves 10, stiff, erect, linear, usually deeply chan-

nelled, 200–500mm or longer, 5–30mm broad, minutely papillate on abaxial surface, margin ciliate with minute teeth. Peduncle underground, 50mm long. Spathe-valves 90–150mm long, 8–12mm broad at the base, narrowing gradually towards the obtuse apex, erect, basal parts encasing the basal portion of flower; bracteoles narrowly linear, 50–80mm long. Umbel (1-2)- to 3-flowered. Pedicels absent or very short. Perianth funnel-shaped, with the tube 100–150mm long; segments thick and fleshy, white with a pink flush, usually keeled with deep pink, 100–135mm long, the inner 25–30mm broad, the outer slightly narrower, conniving to form a funnel with only the upper third spreading to slightly recurved; apical peak on the inner segments short, 1mm long, on outer up to 5mm long. Fruit beaked, subglobose, 20mm diameter. Seeds large, blackish and distinctly papillose and rugose.

Crinum acaule is undoubtedly one of the most spectacular species of *Crinum*. Although few-flowered, its flowers are larger than any other southern African *Crinum* species. Flowers are strongly scented, particularly in the late afternoon. It is a rare endemic to Zululand in KwaZulu-Natal, but it might occur in southern Mozambique.

Contrary to available literature, the seed of this and the following species is blackish and distinctly papillose and rugose.

Crinum minimum Milne-Redhead in **Kew Bull**. 1947:33 (1947); Sölch in **Prod. Fl. S.W. Afr**. 150:7 (1969); Geerinck in F.A.C., **Amaryll**.: 9 (1973); Verdoorn in **Fl. Pl. Afr**. 40: t. 1577 (1969); Verdoorn in **Bothalia** 11:40 (1973); Roessler in **Mitt. Bot. München 11**:539 (1974); Nordal in **Norw. J. Bot**. 24:185 (1977); Nordal in **Norw. J. Bot**. 26: 150 (1979). Type: Zambia, Mwinilunga, Cha Mwana Plain, ***Milne-Redhead 2761*** (K, holo., BM, BR, PRE!).

C. walteri Overkott in **Mitt. Bot. Staatss. München** 1:444 (1954). Type: Beulah [not Benloh or Benhop as in diagnosis and Verdoorn 1973], ***Schwerdtfeger in herb. Walter 1/302*** (M, holo.).

Bulb 40–80mm long, 30–50mm diameter, forming a distinct neck 3–80mm long. Leaves few, narrowly linear, flaccid, 100–180mm, 1.5–4mm broad when flattened, glabrous, margin involute, smooth. Peduncle short, usually above ground, arising from dense papery tunics at the apex of the bulb, 30–110mm long. Spathe-valves soon becoming thin and papery, 70–100mm long, 3–9mm broad at the base, narrowing towards the apex. Umbel usually solitary, sessile. Perianth with a tube 80–120mm long; nodding; segments thin, white with a deep rose dorsal keel, sometime pale pink, 90–120mm long, 8–15mm broad, attenuate to an acute apex, the outer slightly narrower, conniving in a funnel shape, somewhat zygomorphic, the three lower segments spreading and the three upper ascending and

somewhat recurved; apical peak 2–5mm long. Stamens declinate, filaments white or pink-flushed. Style declinate, deep rose. Fruit presumably beaked, subglobose, 20mm diameter. Seeds blackish and finely papillose.

This species is widespread in the northern parts of southern Africa: Namibia, Zimbabwe, Zambia and Zaire (Fig. 1). In East Africa it is only known from the Serengeti in North Tanzania (localities of the last three mentioned countries were not included in Fig. 1). It presumably has never been collected from Mozambique. *Crinum minimum* is remarkably uniform over its distribution range. The species does not seem to be rare, but in leaf it is inconspicuous, and will be found only when in flower after good rains.

C. parvibulbosum Dinter ex Overkott in **Mitt. Bot. Staatss. München** 1:444 (1954); Nordal in **Norw. J. Bot.** 26:151 (1979). Type: Namibia, Karibib, ***Dinter 6793*** (M, holo., G, PRE!).

Bulb 40–90mm long, 30–50mm diameter, forming a distinct neck 40–100mm long. Leaves 10, linear, flaccid, 100–200mm, 2–5mm broad when flattened, glabrous, margin flat or involute, smooth to scabrous. Peduncle short, above ground, arising from dense papery tunics at the apex of the bulb, 30–110mm long. Spathe-valves thin and papery, 60–80mm long, 2mm broad at the base, narrowing towards the apex. Umbel 1 or 2. Perianth with a tube 80–130mm long, nodding; segments thin, white with a deep rose dorsal keel, sometime pale pink, 50–100mm long, 10–20mm broad, attenuate to an acute apex, the outer slightly narrower, conniving in a funnel shape, apical peak 2–5mm long. Stamens declinate. Style declinate. Fruit unknown.

This is the species discussed and illustrated under the name *C. acaule* by Lehmiller in **HERBERTIA** 48:81 (1992). At present it is known only from Namibia. There could be an almost sympatric distribution (Fig. 1) between *C. minimum* and *C. parvibulbosum* in Namibia that should be investigated with more fieldwork. The choice of rank in this group should be reviewed when more information is available.

DISCUSSION

Nordal (1979) considered the group of slender species of *Crinum* polyphyletic, *i.e.* they are more closely related to other species of *Crinum* than to each other. Adaptation to arid areas with sandy soils seems to have led to the evolution of slender plants which grow out after rains. *Crinum minimum*, which grows in shallow or stony sandy soil, seems to have evolved by reduction from an unknown species or from *C. foetidum* Verdoorn. However, the genus is still not very well known for large areas of southern tropical

Africa. For example, *C. parvum* Baker is a poorly known taxon with an unknown origin, first thought by the author to come from the banks of the Zambesi, and later from Nyassaland. Nordal considered this species conspecific with *C. acaule,* however, it could equally well be conspecific with *C. parvibulbosum.*

Given the almost overlapping distribution of *C. parvibulbosum* and *C. minimum* in Namibia, and their morphological similarity, perhaps the former should be reduced to infraspecific rank. However, *C. acaule* and *C. minimum* are clearly distinct entities.

Contrary to Verdoorn (1969, 1973), the seed of *C. acaule* and *C. minimum* is blackish and distinctly papillose and rugulose. The only other species of *Crinum* known with black, papillate seeds are *C. foetidum* and *C. papillosum* (Nordal 1977). In addition, Lehmiller (1992) described and illustrated the seeds of a plant of *C. graminicola* with greenish to brownish-black seeds with a fibrous coat. This plant can only be *C. foetidum* as plants of *C. graminicola* I investigated near Pretoria have light-coloured, smooth seeds. The type of seed could be informative in discovering the relationships of this small but interesting group of *Crinum.*

ACKNOWLEDGEMENTS

I would like to thank Charles Craib for bringing the two species of *Crinum* under the attention of the National Botanical Institute. I would also like to thank Andrew Blackmore of the KwaZulu-Natal Parks Board for his hospitality during a short visit to St. Lucia, during which Gill Condy completed the plate of *C. acaule.*

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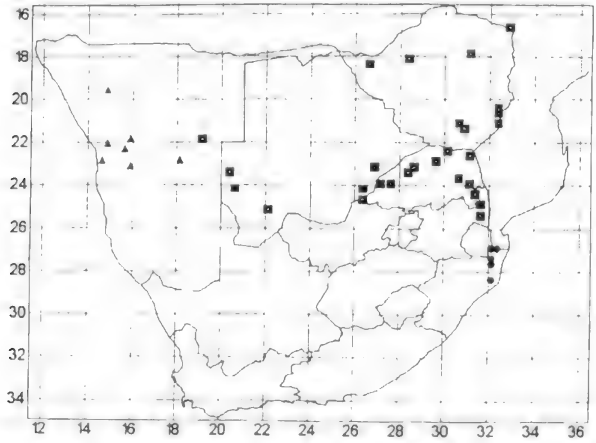

Figure 1. Distribution of *C. acaule* (●), *C. minimum* (■) and *C. parvibulbosum* (▲), according to specimens in the National Herbarium (PRE).

CYBISTETES AND FERRARII— A RESPONSE FROM LES HANNIBAL

I have several reasons for commenting on the misleading caption placed under the color plates on page 32 of the 1996 **HERBERTIA**.

First, the distinctions between *Ammocharis* and *Cybistetes* are of a primitive evolutionary adaptation: *Ammocharis* has actinomorphic primitive blossoms dating back to its origin from *Stenaster* aquatic *Crinum*. In turn, *Cybistetes* has zygomorphic blossoms dating back to those *Crinum* which became land adapted—all according to Ledyard Stebbins, **Flowering Plants, Evolution Above The Species Level**. So if you examine the photo (page 32, Vol 51) of the so-called *Cybistetes* it obviously has actinomorphic blossoms on uncurved pedicels which identifies it as *Ammocharis*. Q.E.D.

Second, *Crinum graminicola* is native to the mid-Transvaal and this area was not explored until after the "Great Trek" by the Cape Dutch near 200 years back. On the other hand, the Jacobian medical monk Father Ferrarii published his **Florvm Cvltvra Libra IV** in 1633. That was 20 years before the Dutch attempted settling Cape Town. Up until then no one risked going inland more than a few miles, so *C. graminicola* was quite unknown!

Chapter two of Ferrarii's **Florvm Cvltvra** is devoted to the Amaryllidaceae, which he called *Lilio Narcissus*. It covers *Narcissus, Pancratium, Zephyranthes atamasco* and a number of Cape bulbs from the Berg River area. The Portugese ships to the Orient used to pull into the Berg River, 100 miles north of the Cape to rid their ships of marine growth and obtain fresh water before returning home. The small streams at the Cape were seasonal, brackish, and too shallow to use. Ferrarii published etchings of *Cybistetes, Amaryllis belladonna, Haemanthus* and *Brunsvigia orientalis*. There also is an illustration of a *Cybistetes* bulb with foliage whose description verifies the identification of his *Cybistetes* plate 119.

Now, it happens that Barrelier (1714) merely copied Ferrarii's above *Cybistetes, Amaryllis belladonna* and the *Cybistetes* bulb in his plates 1039 and 1942, adding the *Cybistetes* bulb to both plates. These copies are obviously reduced in size and in reverse, typical of copied etchings! Dr. Traub, in his eagerness to transfer *A. belladonna* to the genus *Brunsvigia*, recognized Barrelier's copy of Ferrarii's *Cybistetes* as that of *A. belladonna major*! So comparison of Traub's plates in the 1983 **Taxon**, as well as **HERBERTIA**, to Ferrarii's original plates is quite interesting. A copy of Ferrarii's **Florvm Cvltvra** is in the Rancho Santa Ana Library (Claremont, California) and book "Secundra" is well worth photocopying as are pages 308-312 on culture. A translation of his 17th century Roman Latin is not easy, but well worth the effort. Ferrarii was a very capable botanist. The

Jacobians had medical gardens in Rome, Florence and Paris. As of now, they seem completely forgotten.

During the last few months I had another occasion to run down early nomenclature which involved *Ammocharis*: in 1827 C.F. Ecklon published his **Topographisches Verzelchness** where he listed a number of plant specimens collected about the Cape of Good Hope, mostly collected in 1825-1827 about the Cape Flats and Table Mountain. He cited a number of Amaryllidaceae using early names from Aiton's **Hortus Kewensis**, Ker-Gawler's 1817 listing of Amaryllidaceae in the British **Quarterly Journal of Arts and Sciences** and other sources. I became interested in tracing several names.

Under genus *Amaryllis* he listed *A. purpurea*. Obviously this was *A. belladonna* but based on Ferrarii's *Narcissus Indicus liliaceous purpurascens* or Barrelier's cribbed *Lilio Narcissus purpurascenes*. Then *A. longifolia* from description of habitat is obviously *Crinum bulbispermum*, not Linnaeus's *C. longifolia* which is *Cybistetes longifolia* (L.) M.-R. & S. His *A. sarniensis* is obviously *Nerine sarniensis*.

Under genus *Brunsvigia* Ker-Gawler we find the following: *B. josephinae* Red.; *B. orientalis* Aiton, now credited to Linnaeus as author, *B. ciliaris*, foliage only—obviously *Boophone ciliaris; B. falcata* [Aiton]—obviously *Cybistetes longifolia* (L.) M.-R. & S.; and lastly, *B. albiflora* Eckl. "Without name or source from Brahm's collection".

What was *B. albiflora* Ecklon? Was it a white-flowered *Brunsvigia* or a variation of *Cybistetes*? Some of the latter variants bear up to 40-50 blossoms, and recently *Ammocharis herrei* was transferred to *Cybistetes*. Were Ecklon's specimens still in preservation?

After some inquiries I finally found that his specimens were in the Swedish National Herbarium and that these specimens had been reviewed by B. Nordenstram in 1972. He had identified the *Brunsvigia albiflora* as a *Crinum latifolium* from India. This seemed out of place. Ecklon had identified *C. bulbispermum* as in the genus *Amaryllis* in keeping with Ker-Gawler's 1817 nomenclature. So since *C. latifolium* blossoms are in subgenus *Stenaster* why hadn't he listed the specimen as an *Amaryllis*? I wrote the Director of the Swedish Herbarium and he kindly sent me a photocopy of the *B. albiflora* Ecklon. It quite obviously wasn't a *Crinum*, and a few minutes checking with Milne-Redhead and Schweickerdt's study in the **Linnean Journal** (1939) confirmed that it was an *Ammocharis coranica* (Ker-Gawler) Herbert.

There is no record of a white-flowered form being found, but the species is widely distributed about Cape Province, so ecological variants obviously exist. Historically, it has been given numerous names, like *Cybistetes*, and this is good evidence that botanists have been misled by the extend of diversification.

Ferrarii issued four publications of **Florvm Cvltvra,** three in

Latin (1633, 1646 and 1664), and one in Italian (1635) where provincial "vulgar" names were used. Here his plate 119 was identified as "Donna-Bella". This soon became attached to plates 121 since *A. belladonna* spread widely through the churches as a medicant as well as an attractive autumn flower, since little else is prone to flower in the autumn about the Mediterranean. Linneaus used the book as a reference at Cliffords when naming and listing the live and herbarium specimens in Clifford's collection.

SCIENCE EDITOR'S NOTE:

While it is true that zygomorphy (bilaterally symmetrical flowers) has been classically considered the derived state to ancestral actinomorphic (radially symmetrical) flowers, there is good evidence to the contrary in Amaryllidaceae. Snijman and Linders (1996), in their meticulous phylogenetic (cladistic) analysis of Tribe Amaryllidaceae (in which *Crinum* belongs), make a very clear case for zygomorphy as the ancestral condition in this tribe. Based on phylogenetic analysis of chloroplast DNA sequences, the genus *Agapanthus* (with zygomorphic flowers) is sister group to the entire Amaryllidaceae (Fay and Chase, 1996). Furthermore, in our sequence data for Amaryllidaceae (Fay *et. al.*, 1995), *Amaryllis belladonna* (with zygomorphic flowers) occupies the basal (ancestral) position in Tribe Amaryllideae.

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Alan W. Meerow, Science Editor

GROWING EULOPHIAS

Brad Carter
UC Irvine Arboretum, Irvine CA

Five years ago the UCI Arboretum began building a collection of *Eulophia* orchids. *Eulophia* is a relatively large group of about 200 species of tuberous terrestrial orchids distributed mainly in central and southern Africa. This group of orchids is relatively easy to grow and has great potential as ornamental plants.

The vast majority of eulophias originate from the summer and year 'round rainfall areas of Southern Africa, areas receiving nearly all of their rainfall during the hot summer months. A prolonged drought occurs during the cool winter months. Most of the eulophias, with the exception of a few saprophytic species, have well-developed subterranean stems or roots, called pseudobulbs, which allow the plants to go dormant during the long dry winter season. When the temperatures begin to rise in the spring, these pseudobulbs sprout and the plant renews its active growth.

In cultivation, we try to mimic the conditions under which a plant grows in nature. Eulophias can be grown outdoors in those parts of Southern California where temperatures do not regularly drop below freezing. Many species grow in forests or along forest margins, so are best grown in filtered sunlight. They need a lot of light to grow well, but they will burn if exposed to full summer sun.

At the UCI Arboretum we grow most of our eulophias in a mix which consists of 1 part vermiculite; 1 part perlite; 1 part peat moss; 3 parts pumice and 3 parts oak leaf mold. This mix provides a loose, well-drained soil medium which simulates the conditions of the forest floor where many eulophias grow in nature. We begin watering in the spring after the eulophias sprout and begin active growth. About one month after initiating summer watering, it is time to start fertilizing. I have had good results fertilizing every other week, alternating between a water soluble 20-20-20 mix and a mix which is low in nitrogen and high in phosphorous and potassium, such as 3-10-10. I find it necessary to spray occasionally for summer pests, especially scale and thrips.

As temperatures begin to drop with the approach of winter, most of the eulophias begin to go dormant; their foliage starts to turn yellow and eventually collapses. Stop watering as soon as you notice the plants going into dormancy and keep the plants completely dry during the entire winter season. It is necessary to shelter dormant plants from the winter rains, otherwise they will rot. Do not resume watering until you notice the dormant plants beginning to sprout in the spring.

Eulophia streptopetala near Harare, Zimbabwe.

Eulophia cucullata at the U.C. Irvine Arboretum.

Photos: Brad Carter

Eulophia speciosa at the U.C. Irvine Arboretum.

Eulophia parviflora at the U.C. Irvine Arboretum

Eulophias are easy to propagate by division. Most produce chains of persistent backbulbs which are linked together by short subterranean stem connections (rhizomes). These dormant backbulbs can be removed from the parent plant by cutting the connecting stem between the bulbs. These backbulb cuttings are then potted separately, using the same mix described above, and should sprout in the spring when the plants resume active growth. Best results are achieved by taking divisions which consist of three attached backbulbs. Do the divisions in January and be very careful not to break off the fragile little eyes or growth buds which may already have begun to swell and grow. Occasionally the divisions will rot, but this can be mitigated by dusting a little bit of fungicide on the wound where the backbulb section is separated from the parent plant. I use powdered rooting hormone because it contains a fungicide and is conveniently available at retail nurseries.

Several of the eulophias are exceptionally showy and easy to grow. *Eulophia streptopetala* is one of my favorites. This medium-size plant produces foliage about one foot [33cm] tall and flower spikes which rise 1½–3 feet [50-100cm]. The flowers are about one inch [2.5cm] wide with green and brown sepals and bright yellow petals. The lip is yellow and purple. This species produces backbulbs which are only half buried, somewhat like a cymbidium orchid.

Another showy, but more rambunctious, species is *Eulophia speciosa*. Plants produces thick one foot tall leaves. The flowers, about 1½ inches [4cm] wide, are bright yellow with purple stripes on the lip. This species has a very long flowering period, beginning in the late spring and continuing for several months. Flowering stems continue to elongate as more blooms are produced, eventually reaching six feet [2m] or more in height. It has a very short dormant period. *Eulophia speciosa* is often found growing near the beach in South Africa and grows very well in pure sand.

Eulophia parviflora is another beach dweller which we grow in sand. Plants are medium to small in size, with nine inch [23cm] tall leaves and slightly taller flower stems. The flowers are very similar to *E. streptopetala*, but are slightly smaller and with brown color suffused on the underside of the two yellow petals. This species is a very dependable bloomer and produces lots of pseudobulbs.

One of the showiest of all the eulophias is *E. cucullata* which produces 2-3 foot [.6-1m] tall spikes which are loosely covered with showy purplish-pink, 1½ inch [4cm] wide flowers. This species is more difficult to grow than the others mentioned here, but the flowers are very nice and it's well worth the effort.

CRINUM MINIMUM: ONE OF SOUTH AFRICA'S MOST UNUSUAL BULBOUS PLANTS

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Crinum minimum is the smallest species in the genus in South Africa. Plants are very inconspicuous when not in flower, having only a few, thin, grass-like leaves about 6–10cm long. The species is known from few herbarium records in South Africa and is under-collected and little studied. A detailed field research programme was conducted on plants in habitat from October 1996 to February 1997 in South Africa's Northern Province. An attempt was made to locate as many colonies of *C. minimum* as possible by searching methodically through suitable habitat in the general areas in which herbarium collections had been made and elsewhere.

Crinum minimum is not only morphologically distinct from all other South African *Crinum* species but also occupies a specific niche in the environment to which it has developed some singular adaptations. These are discussed in this paper.

The three populations studied probably were representative of the main habitats occupied by this species in the Northern Province. All of them were found in Acock's Sweet Bushveld (Acocks 1988), two colonies in the variant Dwarf *Combretum apiculatum* Veld and one in the variant *Adansonia* Mixed Thornveld.

Plants were found only at three localities although at least 400 roadside sites were investigated. The *modus operandi* concerned searching through likely looking habitat and noting the presence or absence of the crinums and associated vegetation. Arid Sweet Bushveld is the characteristic veld type of much of the northern and northwestern parts of the Northern Province. The climate is hot and dry with rain falling between October and April, mainly in the form of thunderstorms. The region is subject to prolonged droughts. The winter months are warm and dry with temperatures sometimes falling below 0°C at night.

CRINUM MINIMUM HABITATS

Verdoorn (1973) noted that *C. minimum* "was found in hot dry country in pebbly, sandy soil on gentle slopes or in open patches near rivers in Mopane-Combretum veld and near Baobab trees...". Combretums and baobabs were found at two of the colonies and only combretums at the other. The colony north of the western end of the Soutpansberg was found in deep red sand near baobab trees. The population near Speculatie in the Ellisras District was found on gentle west-facing slopes in red sandy loam amongst white quartz stones. The largest colony, near Steilloopbrug north

Crinum minimum in flower. Watercolour painting by Gillian Condy. The plant was growing in stony sandy soil at the Steilloopbrug colony and came into flower on 11 December 1996. The plant on the left flowered in the second half of November and had formed a fruit by mid-December. Note the very thin grass-like leaves which characterise this species and the formation of the fruit at ground level.

of Potgietersrus, was found in sandy pebbly and stony soil close to the Magalakwena River.

CRINUM MINIMUM NEAR STEILLOOPBRUG

Crinum minimum was recorded from the Steilloopbrug area in mid- and late November 1966. This region lies within extensive game and cattle ranches and the former national state of Lebowa.

A search was conducted in late October, thirty years after the records were made, in the same general area. The first rains of the season had just started to fall but no plants were found. Other bulbs had emerged and were in flower, such as *Scadoxus multiflorus* and *Crinum buphanoides*. A second visit was made to the area in mid-November, after good rains had drenched the Northern Province. Several populations were found at one locality, comprising small groups of 1-10 plants, most consisting of 3-4 plants growing in sandy, stony or pebbly soil in distinct niches. Some grew at the sides of rocks, others at the edges of sheets of exposed rock in the manner of some *Brachystelma* species, and others grew in sandy soil lying over sheets of rock. Plants grew mainly in the open or occasionally under small combretum bushes.

About 70 plants were found in an area of about one square kilometre. Five plants were in bud and most of the others had fully developed leaves. A few were just starting to sprout leaves, hardly visible above the surface of the soil.

A second visit was paid to the area in late November. The plants in bud had flowered and were starting to form seeds. Two more plants were in flower and about five more were in bud or starting to develop buds. The next visits in December coincided with hot dry weather. All the plants which had been in flower had started to form seeds but no other specimens were observed in flower or bud. An extensive search was conducted in the general area in suitable habitat but no further plants were located.

CRINUM MINIMUM NEAR RUSTENBURGKOP

A colony of *C. minimum* comprising about 25 plants was found near Rustenburgkop about 30km northeast of Ellisras. The colony was widely scattered in stony red sandy loam on the lower west-facing slopes of a quartzite ridge. The area comprised dense mixed *Acacia* and *Combretum* veld with open patches. An investigation was made of the east-facing slopes of the quartzite ridge but no plants were found here.

At the time the colony was found in mid-November, heavy rains had fallen; the veld was very green. About five of the plants were in bud. Plants grew out in the open in stony patches, less frequently in bare red loam, and occurred either singly or in groups of 2-4.

Three subsequent visits were paid to the area in late November, December and mid-January 1997. No further plants appeared to have flowered. The general area was searched more thoroughly but no further colonies of plants were found.

CRINUM MINIMUM NEAR SOUTPAN

The Saltpan is situated in an arid rain shadow area immediately north of the western end of the Soutpansberg. The mountain range takes its name from the Saltpan (*Soutpan* in Afrikaans). A colony of about 35 *C. minimum* was found in late November 1996 in deep red sand near baobab trees, west of the Saltpan. The plants were growing singly or in small groups of 2–5, usually out in the open or at the sides of combretum bushes.

Good rains fell in November and early December stimulating most bulbous and caudiciform plants to flower. Five visits were paid to this locality between late November 1996 and mid-January 1997. None of the plants appeared to have flowered but they were all in full leaf. An extensive search was conducted all over the area but no further colonies of *C. minimum* were located. It is interesting to note that the species was recorded in the same area at the end of October 1955, about 42 years beforehand.

THE GROWTH CYCLE

Crinum minimum starts to grow once the first substantial rains of the summer have fallen in the Northern Province, usually between October and early December. The first plants to commence growth are usually those in sandy soil at the edges of sheets of exposed rock or around rocks. Sheets of exposed rock act as water catchments and the ground becomes saturated even after light showers. This is not the case in the sandy habitat north of the Soutpansberg where good rains need to fall to saturate the ground below levels of 10cm [4 in] or more, the depth at which the *C. minimum* bulbs are situated in the ground.

Crinum minimum comes into flower 2–3 weeks after sufficient rains have fallen to initiate the growth of leaves. Flower buds take about 7–15 days to develop from the stage where the bud is visible at ground level until the time the flower opens. Flowers last for 1–6 days, usually 2–3. Fruits and seeds take longer to develop in *C. minimum* than other *Crinum* species. From the time the flowers are pollinated until seed is liberated is usually 7–10 weeks with at least another 3–6 weeks (or more) until the seeds start to develop a radicle.

Flowering is erratic, with a peak during November and early December during years of good rainfall. Flowers are produced mainly from late October until early February, usually initiated by good

rainfall. During 1997, a year of good rainfall, flowers were only noted at the Steilloopbrug and Rustenburgkop populations, with less than a quarter of the plants at both populations flowering.

Each bulb produces one flower a year, and occasionally flowers twice in a season. Usually one to three seeds are produced in the capsule, commonly only one. Seeds are small and light and are distributed mainly by rainfall where runoff is heavy, such as around sheets of exposed rock. Seeds may be moved many metres from the parent, whereas in drier times, with little rainfall in the later summer months, seeds remain stationary and germinate around the bases of the parent plants. At the Steilloopbrug population the plants occur either singly or in small groups. This appears to be directly related to the distribution patterns of the seeds during years of good or poor rainfall.

North of the Soutpansberg, at the population near the Saltpan, good rains simply saturate the deep red sand and water run-off hardly distributes seeds. Grazing cattle and antelope kick the seeds around to some extent and they are responsible for burying some of the seeds under the sand (where they are unlikely to germinate) while distributing others. Nearly all the plants in the vicinity of the Saltpan were found in small groups indicating that the majority of the seeds had germinated around the parent plants.

Rainfall is a significant factor in seed distribution at the Rustenburgkop population. The red sandy loam becomes hard during dry spells with high run-off when the next rains fall. The rain washes seeds against rocks where they obtain the chance to germinate; seeds which do not land in such situations usually shrivel in the intense summer heat when the ground becomes hard and dry.

During hot dry spells the leaves of *C. minimum* often die back and the bulbs enter dormancy only to grow out again during the same season when the next good rains fall. This habit might be unique amongst South African crinums which generally produce one set of leaves a season.

ASSOCIATED FLORA AT THE THREE COLONIES

Crinum minimum is associated with a rich bulbous and succulent flora at the Steilloopbrug colonies. *Anacampseros rhodesica* is common in shallow sand over sheets of exposed rock, with *C. minimum* sometimes surrounded by dense groups of these plants. *Pterodiscus luridus* is also frequent, growing in scattered groups around low rocks close to the populations of *C. minimum*. Amongst bulbous plants, several *Albuca* species and *Scadoxus multiflorus* are frequent. *Sansevieria pearsonii* grows in dense stands where the soil is deep, but usually avoids the rocky-sandy niche specifically occupied by *C. minimum*.

The Saltpan *C. minimum* grow together with strong populations of Devil's Claw, *Harpagophytum procumbens* subsp. *transvaalensis*, *Sansevieria pearsonii* and some huge examples of *Adenia spinosa* which are probably a few hundred years old. Large baobab trees, *Adansonia digitata*, are frequent. Nearer to the Saltpan, *Sesamnothamnus lugardii* occurs in dense arid forests as well as *Ipomoea adenioides* in particularly dry situations.

At the Rustenburgkop population there are various albucas present and in the low-lying areas where the soil is sandy, large populations of *C. buphanoides* and a few groups of *C. foetidum*. *Pterodiscus luridus* also is frequent in this area. A unifoliate *Albuca* species with serrated leaf edges also is present for about three weeks after the first good summer rains have fallen. This species, which may be undescribed, is sparse at this locality but frequent around Alldays, a small town to the northeast.

ADAPTATIONS TO AN ARID ENVIRONMENT

Crinum minimum differs in several significant ecological respects from all other South African *Crinum* species. This is discussed below with reference to the plants' growth cycle, and their flowering and seeding habits. These are compared to other *Crinum* species and Amaryllidaceae found in the arid parts of the Northern Province and a few other succulents and caudiciforms which grow in the same habitat as *C. minimum*.

Crinum buphanoides is frequent in the Northern Province; *C. delagoense* is locally distributed in some areas such as around Alldays and *C. foetidum* is locally distributed in sandy areas mainly north of Ellisras. All of these species produce leaves in October, irrespective of rainfall—in the case of *C. buphanoides* even during severe and prolonged droughts. *Crinum minimum* does not appear until substantial rains have fallen which penetrate the ground to at least the depth of the bulbs. During severe droughts *C. minimum* remains dormant. The habit of producing foliage in spring irrespective of rainfall is shared by all other South African *Crinums*, even *C. campanulatum* which sends up a few leaves in the dry clay pans where it grows, often before the spring rains which flood the pans.

The three other Northern Province *Crinum* species all flower during a 3–4 week period after rains have fallen in late October and November. Copious amounts of seed are set by *C. buphanoides* and *C. delagoense* and, to a lesser extent, *C. foetidum*. This occurs between 4–6 weeks after flowering. During years of average or above average rainfall most plants flower and set seed, some even during droughts. The seeds, which are heavy, generally germinate in the vicinity of the parent plants. They often are consumed in large numbers by the Amaryllis Caterpillar, *Brithys trinii* subsp. *pancratii*.

Few *C. minimum* flower in given populations in any one year in seasons of average or above average rainfall. During dry years most of the population remains dormant.

Nerine laticoma occurs sparingly in the Northern Province and there are a few populations around Alldays. The plants emerge and flower if there have been good rains in November. Little seed forms and ripens unless the rains which initiated flowering are followed by regular rainfall. Good seed sets generally are observed only when there is regular rain throughout the summer.

The unifoliate *Albuca* species flowers after good early summer rains, sets abundant seed and then enters dormancy. The growth cycle from emergence of the leaves until seeding is only about a month. The bulbs are very shallow in the soil and survive the arid conditions by remaining dormant for most of the year until good rains fall and then setting abundant seed.

Harpagophytum procumbens subsp. *transvaalensis*, a caudiciform which grows with *C. minimum* near the Saltpan, usually flowers after the rains which normally occur in November. Fruits are formed in January but these do not split open and liberate seeds until late the following winter, spring and summer. Each seed in encased in a coating which is initially impervious to water and needs a few months to decompose before the seed inside is ready for germination. Seeds at the back of the fruit are not released until the fruit decomposes fully after three years. In addition to this natural protection, the seed coat contains inhibitors which stagger germination for up to a few years.

Crinum minimum produces few seeds each season after the erratic flowering of a few plants in a given population. This takes place over an extended period insuring that some ripe seed will be present when conditions are suitable for germination. The flowering and seeding characteristics of *C. minimum* explain why populations are sparse with limited numbers of individual plants.

HORTICULTURE

Crinum minimum is one of South Africa's most unusual and attractive *Crinum* species because of its thin grass-like leaves and large single inflorescence scented like frangipani flowers. It flowers erratically in cultivation and should be grown in sandy soil in large asbestos or earthenware containers. If correctly grown, it should be in leaf throughout the summer and flower erratically as it does in nature. Flowering usually takes place immediately after cool prolonged rainy weather for plants grown out in the open. When plants are kept too dry they do not produce any leaves and when kept too moist the leaves "damp off" periodically, even though the bulbs may not rot. A mulch of fine pebbles on the surface of

the soil retains moisture underneath during hot dry spells.

Specimens cultivated with the pebble mulch in Johannesburg, South Africa, have grown and flowered better than plants grown in earthenware containers without the pebble mulch. Plants cultivated out-of-doors in Johannesburg have grown well when watered thoroughly about once a week in summer and grown in morning sun in light dappled shade.

Seed should be harvested at the time the seed capsule begins to decompose. It should then be kept in a shallow dish in a warm room until the radicle starts to form and emerge from the side of the seed. This process can take from about 6-10 weeks. At this stage the seed should be planted in a thin layer of pure silt on top of a mixture of half silt and half sandy soil, placed in a large asbestos or earthenware container. The radicle should point downwards resting on the surface of the soil. The seed should not be pressed more than half its size below the surface of the soil. The watering regime should be the same as for adult plants.

During the winter months in South Africa *C. minimum* should be watered lightly about once a month in the middle of the day, avoiding any watering during cold spells. A small quantity of bonemeal (about a teaspoon) in large containers, should be mixed into the growing medium for both adult and seedling plants when the pots are prepared for cultivation.

ACKNOWLEDGEMENTS:

I thank Clare and Robert Archer of the National Botanical Institute, Pretoria, for permitting me to examine *C. minimum* herbarium material and for their interest and encouragement with this research.

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LIVING JEWELS: NUMBER 4 IN A SERIES

NARCISSUS CALCICOLA

Charles Hardman
Baldwin Park, California

If you love the the tiniest of the tiny, the miniature minatures of the flowering bulb world, do give *Narcissus calcicola* a try. I got seeds of this species in 1990 from the IBS Seed Exchange and planted them in December of that year. They bloomed for the first time in spring, 1996, shocking me with their tiny 'King Alfred'-like perfection. I'm sure they would have bloomed a year or two earlier had I fed them a bit more potassium and phosphorus while they were growing up. But the species was new to me and I felt it better to err on the side of mild starvation rather than risk losing the bulbs to overfeeding.

My mature *N. calcicola* plants range in height from 3 inches (7.5cm) to the giant among them which towers over the others at a height of 4 inches (10cm). My plants set seed easily but only after I make several rounds of the flowers with a camel's hair brush, lifting the pollen from the anthers of one flower and transferring it to the stigma of the next. Each stigma is pollinated twice so I am sure each receives as much pollen as it can hold and from many clones. Several such forays into the blooming potful of plants are required of me each blooming season as the flowers open over a period of several weeks and I want to make certain to set as many seeds as possible. Even so, not every flower makes a seed pod. I end the seed gathering season grateful for the seeds I have collected and, often enough, amazed at the quantity of seed each tiny pod is capable of producing.

According to David Adams *Narcissus calcicola* can be used in hybridizing with other species. Mr. Adams writes, "The resulting miniature hybrids are most special and will equal the best of other hybridists."

I'm not surprised. This species is delightful in its own right. From time to time the IBS Seed Exchange lists seeds of this wonderful, surprisingly tough cutie.

This species sure can take the heat, as this horribly hot, dry Southern California spring of 1997 has proven. Its flowers stood up to 90°F+ heat day after day—and even one day when the temperature got up to 98 F—with fresh smiles on their little faces.

A native of West Portugal, it's doubtful that this species has much cold tolerance. But then, you never know until you've tried. (Personally, I would hate to lose so much as one bulb or seed of this tiny tot just because I wanted to test its cold tolerance. But

then, that's me. Maybe if I had a jillion of them!)

My soil mix is pure crushed granite sand with an inch of Super-soil™ (ground bark product) topdressing. A little fertilizer with potassium, phosophorus and a little nitrogen (nitrate: potassium nitrate or calcium nitrate—not nitrite—nitrogen, if possible; if not, use what you have, sparingly) used in small quantities three or four times during their growing season (winter-spring for me) will help your bulbs grow to blooming size quickly.

Treat them well and this species will come back year after year, multiplying and blooming better the older they get. Divide during dormancy when they're crowded in the pot or in the space you've provided them.

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Narcissus calcicola

Photo: Charles Hardman

BRUNSVIGIA MARGINATA HYBRIDS

Thomas M. Serrett
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About ten years ago I ordered a number of *Brunsvigia* species from South Africa. I then planted the bulbs out in my fields. Among the species ordered was *Brunsvigia marginata.* It bloomed for a few years and then died. It is the only *Brunsvigia* species I have grown that has died, but before it died, either I or the bees crossed it with some of my other *Brunsvigia* species.

For years I tried raising *Brunsvigia* seedlings in pots with disastrous results as many of them kept dying off. Finally, I said to hell with them and planted all of the remaining seedlings out in the fields under drip irrigation lines which water my fruit trees. Of course, this meant that the bulbs received water the year around.

Much to my surprise, the bulbs grew like weeds. Three years ago they started to bloom and I was even more surprised as they were all hybrids of *B. marginata.* So far six have bloomed and I have five red or crimson and one pink flowered plant. From studying the leaves of the remaining seedlings I think I have two more hybrids left to bloom.

I now believe that *B. marginata* died because Southern California is too dry for it. If the bulbs had been near a drip line I think the bulbs would still be alive. Apparently *Brunsvigia marginata* needs water the year around.

Brunsvigia marginata hybrids growing in the ground and watered by drip irrigation.

Photos: Thomsas M. Serrett

AMARYLLIS ORNATA L.f. IN AITON, UNPUBLISHED MANUSCRIPTS OF LINNAEUS FILIUS, AND *CRINUM* SERIES *ORNATA* HERBERT

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INTRODUCTION

Carl Linnaeus the younger, referred to as Linnaeus filius in botanical literature, lived in the shadows of his father's greatness. After his father's death in 1778, Linnaeus f. not only preserved and continued his father's work, but he proved to be a very competent botanist. When Linnaeus f. unexpectedly died at age 43 in 1783, he was in the midst of compiling a "Manuscript" dealing with the Amaryllidaceae. The unnamed and unfinished Manuscript was never published, but while visiting England in 1781-82, Linnaeus f. shared portions of the Manuscript with Dryander, editor of Aiton's **Hortus Kewensis**. In the first edition of **Hortus Kewensis** (1789), Dryander acknowledged Linnaeus f. for sharing portions of the Manuscript and indicated that new plant descriptions provided by Linnaeus f. were "quoted" from the Manuscript. Twenty-seven species appearing in **Hortus Kewensis I** were attributed to Linnaeus filius.

Savage (1937) provided an illuminating account of the origin and the posthumous treatment of Linnaeus filius's Manuscript; Savage included a detailed synopsis of all genera and species covered in the Manuscript. While reviewing Savage's article, Lehmiller (1993) noted discrepancies between the principal references for several *Crinum* species cited in the Manuscript with the published account in **Hortus Kewensis I**, a transgression which blurred the identities of *C. americanum* L. and *C. erubescens* L.f. in Aiton.

AMARYLLIS ORNATA L.f. IN AITON

As published in **Hortus Kewensis I**, the identity of *Amaryllis ornata* L.f. was ambiguous because the description was vague and there was no reference to a specimen or published figure, other than a dubious citation to a painting punctuated by a question mark (see Article 34.2 of the International Code of Botanical Nomenclature). Consequently, the identity of *A. ornata* became mired in controversy, as subsequent botanists were forced to rely upon assumptions. Many different species were lumped together as synonymous with *A. ornata* (Ker-Gawler, 1809, 1810; Aiton, 1811), and this confusion carried over into *C. ornatum*—to be discussed later. The specific description listed in **Hortus Kewensis I** was:

ornata. 12. A. Floribus sessilibus, corollis basi tubulosis; tubo spathis limboque longiori curvo, limbi laciniis oblongis aris-

tatis; lacinia infima divaricata concava. Linn. fil.
Cape Coast Lily. Nat. of Guinea.
Cult. 1740, by Robert James Lord Peter. Ehret pict. t.5.f.2?
Fl. June and July.

According to Articles 7 and 8 of the International Code of Botanical Nomenclature, when the identity or holotype of a taxon was in question, then the original author's protologue should be examined and followed as a guide. Since Savage's review implied that Dryander had also misquoted Linnaeus filius's accounting of *A. ornata*, this author visited the Linnaean Society of London in November, 1995, in order to scrutinize Linnaeus filius's Manuscript.

After registering at Burlington House, the librarian graciously gave me a tour of the Linnaean Society's massive vault where Linnaeus's books, correspondence, and personal papers are preserved, including the papers of Linnaeus filius. The librarian brought forth a drawer containing not only Linnaeus filius's Manuscript, but also its apparent predecessor, a brief planning outline upon which Linnaeus f. had written the title "Liliacea". Savage (1937) discovered Liliacea only after submitting his article to **HERBERTIA**, but he added a footnote in the galley proofs wherein he remarked that Liliacea was an early draft of the Manuscript.

In Liliacea, Linnaeus f. inscribed a general diagnosis for *A. zeylanica* and included reference figures, supporting items and a locality. However, several descriptive elements, a reference figure, and the locality were lined out, several additions were incorporated, and in the same pen as used to make these changes, he wrote *ornata* above *zeylanica*. All particulars lined out in Liliacea subsequently appeared with *A. ornata* in the Manuscript, indicating that Linnaeus f. formulated his concept of *A. ornata* while composing Liliacea and intended *A. ornata* to be distinct from *A. zeylanica*.

The unfinished Manuscript contained 196 handwritten pages wherein taxonomic descriptions were provided for four genera and 70 species. The attention afforded to *A. ornata* was surprising, the description and comments covering four pages on folded sheets numbered 95 and 96 (Fig. 1). Linnaeus f. recorded the following:

Ornata Amaryllis floribus sessilibis, corollis basi tubulosis; tubo spathis limboque longioria curvo, limbi laciniis oblongis aristatis; lacinia infima divaricata concava.
Rumph: Amb: V. p.306. t.105. Tulipa Javana.
Habitat in Africa: Guinea. Vulgo-Cape-Coast-Lily, ex Horto in Wimblington, Lord Rockingham.
(Detailed Latin description: 2+ pages)
obs: figuram coloratam hujus vidi in Musaeo Dni Banks in

patriae cura Smeathmanni facta.
plantam vivam ex horto Dni Rockinghamm habui.

Upon comparison, the general description for *A. ornata* in **Hortus Kewensis I** was "verbatim" from the Manuscript, and the locality, reference to Cape Coast Lily and cultivation by Lord (Petre) Rockingham were correctly portrayed. However, the discrepancy between the two accounts was shocking: Dryander replaced Linnaeus filius's principal reference—Rumph., **Amb**., V., p.306, t.105 Tulipa Javana—with Ehret pict. tab.5, Fig.2? (Lilio Narcissus Africanus). Perhaps Dryander recognized the underlying problem: Tulipa Javana, an Indonesian bulb, could not be the principal reference for an African species, but literary evidence implied that Dryander thought otherwise. Dryander later agreed with Ker-Gawler (1809) that the African *A. ornata*, the Indian *A. zeylanica* and *A. latifolia*, and Rumphius's Tulipa Javana were all the same species. Regardless of his opinion, Dryander was dishonest by making the substitution for Linnaeus filius's principal reference without an explanation. Linnaeus f. would not have authorized the substitution: in the Manuscript, Linnaeus f. listed three reference figures (optima, median, and mala) beneath his description for *A. zeylanica*—Ehret: pict. t.5, f.2 was depicted as "fig. median". Linnaeus f. acknowledged *A. zeylanica* as "habitat in Zeylonica" and separate from *A. ornata*, and he even commented that Ehret believed *A. zeylanica* originated in Africa.

According to Article 7 of the **International Code of Botanical Nomenclature**, Rumphius, **Herbarium Amboinense**, Volume 5, p.306, t.105 Tulipa Javana is fixed as the nomenclatural type specimen for *A. ornata* L.f. in Aiton. However, this Asian reference, cited as a synonym for *A. zeylanica* L. by Linnaeus (1759, 1762), cannot be applied to an African species in the context of Linnaeus filius's protologue. *Amaryllis ornata* L.f. in Aiton must be reserved for an Asian species if it is to be a distinct entity.

CRINUM SERIES *ORNATA* HERBERT

The initial combination of *Crinum* with *ornatum* in botanical literature occurred in the discussion following Herbert's (1820) characterization of *C. broussonetii* (Rédouté) Herb., wherein Herbert referenced *C. ornatum* to an unpublished manuscript of Carey. Herbert, though, did not provide a description, figure, or published reference, so this was not a valid publication of a botanical taxon. Herbert later commented (1824) that Carey's bulb was not to be named *C. ornatum*; Herbert, after receiving a bulb from Carey of the subject plant, named it *C. careyanum* Herbert.

In his **Appendix**, Herbert (1821) formally subdivided the genus *Crinum* into sections and subdivisions, providing Latin descrip-

tions and criteria to define these rankings above the species level. He assigned all known species to this scheme and included appropriate reference citations. Within this scheme was the following:

SECTIO 2. SEMIPATENES

Subdivisio 1. ORNATAE; ante expansionem nutantes. Quoad novi, tubo curvatiore, persistente vel una cum corolla marcescente, tropicae, bulbo sphaerico, foliis saepius undulatis, germine sessili, loculis 2-polyspermis, filamentis magis declinatis et fasciculatis.

(Ten species with references listed.)

Herbert did not designate a type species (*C. ornatum*) for the subdivision. Herbert employed this scheme for several years, for in 1824, he classified *C. caryeanum* into **Sect. II. Semipatentes, Subd. I. Ornatae**. (Subdivision is not recognized as a ranking term in the **International Code of Botanical Nomenclature**; the appropriate term would be "series".) The taxonomical classification which Herbert established was *Crinum* series *Ornata* Herb., and this became the priority taxonomic link between *Crinum* and *ornatum*.

Herbert (1824) anguished over the identity of *A. ornata* L.f. in Aiton. Contributing to his confusion was a specimen in the Bank's Herbarium dated 1785, some two years after Linnaeus filius's demise. This specimen had been labeled "*A. ornata* Linn. fil., Cape Coast Lily form" by an unknown individual sometime between 1785 and when examined by Herbert; the origin of the specimen was also lacking. Herbert thought that this specimen corresponded to *C. broussonetii* (Rédouté) Herb., and he commented that if any plant was to be named *C. ornatum*, then it should be *C. broussonetii*. (Note: It was not possible for Herbert to have examined Linnaeus filius's Manuscript in 1824, because following the death of Linnaeus f., his widow sold the Linnaean Collections and these remained in private hands until they were purchased by the Linnaean Society of London in 1829.)

Herbert (1821) listed the origin of *Crinum* series *Ornata* as "tropical", and of the ten species comprising the series, four originated in Africa, five in Asia, and one of dubious identity he later retracted and said was a hybrid. Herbert (1837) subsequently modified his concept of *Crinum* series *Ornata* with ten species to "*C. ornatum*" with eight varieties, and interestingly, Herbert changed the origin of "*C. ornatum*" to Asiatic—all African species in *Crinum* series *Ornata* were reclassified. Why did Herbert change his mind about the synonymy between *C. broussonetii* and *A. ornata* L.f. in Aiton? Did Herbert examine Linnaeus filius's Manuscript between 1829 and 1837? Herbert did not indicate that he had seen the Manuscript, but circumstantial evidence suggested that he had, for

under *C. ornatum*, var. 6. *moluccanum*, he cited Tulipa Javana Rumph. **Amb.**, the only time Herbert mentioned this reference. Herbert was the only botanist to equate *C. moluccanum* R. in Herb. with Rumphius's Tulipa Javana. Even Carey, Editor of Roxburgh's **Flora Indica** and Herbert's friend, did not make the connection between *C. moluccanum* and Tulipa Javana, even though Carey acknowledged that *C. moluccanum* had been acquired by the Calcutta Botanic Garden from Amboina (Indonesia).

Bury (1832) published an illustration (t.18) which she labeled "*Crinum ornatum*", and in her commentary, she characterized the bulb as: "It belongs to Mr. Herbert's subdivision of *Crinum* the *Ornatae*, in which he enumerates ten species, the names to which seem to have been so differently assigned in various botanical works, as to render them very difficult to distinguish". The bulb depicted in her illustration was obtained from a greenhouse; the bulb's origin was not provided. Bury cited only one reference: **Bot. Mag.** t.1253. Bury's comments indicated that she was unable to classify her plant within the ten species of *Crinum* series *Ornata*, and she made no attempt to do so. Why she cited **Bot. Mag.** t.1253 was peculiar because this citation was the type specimen for *C. distichum* Herb. in *Crinum* series *Ornata*, and her illustration did not correlate with **Bot. Mag.** t.1253. Bury's t.18 illustration was incorrectly labeled; it should have been designated as *Crinum* series *Ornata* Herbert.

The saga over the identities of *A. ornata* and *C. ornatum* continued post-Herbert, but an accounting would be too lengthy to recount. Briefly of importance: Baker (1888) listed *A. ornata* Ait. as synonymous with *C. yuccaeflorum* Salisb. and with *C. broussonetii*, and he placed Bury's t.18 illustration with *C. sanderianum* Baker. During the last 40 years, several botanists, most notably Hepper (1968), recognized Bury's (1832) publication as establishing *C. ornatum* (L.f.) Bury and her t.18 illustration as the lectotype specimen. However, according to Bury's account, she specifically referenced *Crinum* series *Ornata* Herb. and its ten species of which she was unable to differentiate, and her illustration of a cultivated bulb of dubious identity and unknown origin cannot be accepted as a transfer of *A. ornata* L.f. in Aiton to the genus *Crinum*. Hepper, Baker, and other botanists would certainly have viewed *A. ornata* L.f. in Aiton differently had they known of Dryander's deception.

DISCUSSION

Linnaeus was inconsistent with his citations for *A. zeylanica/C. zeylanicum*, and since he referred to multiple illustrations in his publications, the identity of this taxon became ambiguous. Moreover, bulbs submitted to European botanists by Indian intermedi-

aries often were accompanied by dubious identifications (see Roxburgh, 1832), further compounding an exact classification. According to Carey, the identities of *C. zeylanicum* and *C. latifolium* became so confused that several European botanists had completely reversed them. Carey, though, was the only author with field experience in observing these species, and he was emphatic that *C. zeylanicum* had leaves with smooth margins while the leaf margins of *C. latifolium* were scabrous. (Smooth versus scabrous margins is a major character to differentiate speciation among *Crinum*.) Partly for the same reason, *C. moluccanum* was easily separated from *C. zeylanicum*, a distinction made by both Herbert and Carey.

Differing leaf margins, smooth versus scabrous, also appeared in Linnaeus filius's Manuscript with regard to the separate classifications for *A. ornata* and *A. zeylanica*. Linnaeus f. (see Figure 1) described the leaves of *A. ornata* as having "margine subcartilaginen et crenata", whereas for *A. zeylanica* he wrote "fol.: subulatis canaliculatis marginatis planis".

CONCLUSION

Amaryllis ornata L.f. in Aiton is typified by Rumph., **Herb. Amb.**, V.5, p.306, t.105 Tulipa Javana. When this taxon is transferred to the genus *Crinum*, the basionym must be accompanied by the nomenclature type specimen, the latter of which is Asiatic in origin. The transfer must also conform to *Crinum* series *Ornata* Herb. and to priority of first valid publication. It follows that *C. moluccanum* R. in Herb., with valid publication date of 1822, origin in Amboina, and designated as synonymous with Tulipa Javana of Rumphius by Herbert in 1837, becomes the pivotal taxon in *Crinum* series *Ornata* Herbert. The transfer of *A. ornata* L.f. in Aiton to the genus *Crinum* thus becomes *C. ornatum* (L.f.) Herb., with *C. moluccanum* reduced to synonymy.

Crinum ornatum (L.f.) Herb., comb. nov. — *Amaryllis ornata* L.f. in Aiton, *Hortus Kewensis* I:418, 1789, and Linnaeus filius Manuscript. Syn.: *C. moluccanum* (R.) in Herb., 1822, 1837. Type: Rumphius, **Herbarium Amboinense**, 5:306, t.105, Tulipa Javana, 1747..

ACKNOWLEDGMENT

New members of the International Bulb Society may not be aware of the many gems which lie hidden in the old editions of **HERBERTIA** and **Plant Life.** In 1985 I was fortunate to acquire a complete library of **HERBERTIA/Plant Life**. Had it not been for Spencer Savage's review of Linnaeus filius's Manuscript in **HERBERTIA** Vol. 4, 1937, I would never have pursued the identity of *A. ornata* L.f. in Aiton.

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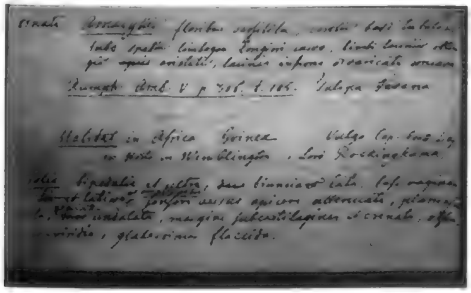

Figure 1. Linnaeus filius's "Manuscript", page 1 of 4 devoted to the taxonomic description of *A. ornata*. Photo courtesy of the Linnaean Society of London.

CRINUM SUBGENUS *CODONOCRINUM* IN SOUTHERN TCHAD AND EXTREME NORTHERN CAMEROUN

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Tchad, an arid landlocked nation in north central Africa, is approximately three times the size of California but only has five million inhabitants. Tchad, or Chad, as it is spelled usually in western cultures, is the poorest country per capita income in Africa. Infant/childhood mortality approaches 25%. The only paved highways are confined to the immediate vicinity of the capital, N'Djamena. Formerly a French colony, Tchad gained independence in 1960, but its political history since then has been marred by continual civil and tribal warfare, and the current government is unstable. Rumors of coups are commonplace. The country is unable to support itself economically and must rely upon foreign aid (mostly from France), and France maintains a military presence to preserve order and to discourage invasion by neighboring Libya, which desires the northern mountainous region where there are uranium deposits.

Lake Tchad, now a mere fraction of its original size, once covered most of southern Tchad. The geological composition of this southern region reflects a lake bottom with silty-sandy-clayish soils that are completely devoid of rocks. Climate and geology divide Tchad into three cultures: 1. The northern region is extremely arid, a mixture of mountains and desert. Its peoples are nomadic Arabs whose economy is herding sheep and goats; 2. The south central zone is known as the Sahel, a transitional climate between the desert and the savannahs/plains, where limited agriculture is possible when supplemented with raising livestock; rainfall occurs only during a distinct rainy season from June through September; N'Djamena lies in this zone and averages 580mm of annual rainfall; the peoples of the Sahel are largely Muslim and semi-nomads; and 3. The southern region lies in the soudanian zone, predominantly savannahs and plains covered with mixtures of tropical/subtropical woodlands and grasses; annual rainfall averages 750-1250mm and occurs during a distinct rainy season from April through October; agriculture is widespread, especially cotton, and the peoples are black Africans.

A non-French tourist must overcome immense bureaucratic obstacles when visiting Tchad. Getting there is a problem unto itself: only two flights a week originate from Paris. On one occasion, my flight to N'Djamena was delayed a day because the airplane had to make an emergency detour to Brazzaville in the Congo to pick up Europeans fleeing political unrest. Then, when returning to Paris, the flight unexpectedly arrived two hours early, so the depar-

ture time suddenly moved up two hours—I barely made the flight. Just to make it through customs at the airport in N'Djamena requires as many as three bribes, and when departing, the final search/inspection by military authorities proceeds at a snail's pace until U.S. dollars appear. Although one dollar bills are absolutely magical, a tremendous amount of time is wasted standing in lines or waiting for the appropriate authorities to approve papers or visas or to come back from lunch break. Time and efficiency are not cultural perspectives in Tchad. Travel about the countryside by vehicle is fraught with inconvenience and unpredictability. Travel authorizations are mandatory, and one must register with the mayor or police chief in each city visited. Military roadblocks and searches are frequent, and travel is restricted if there are suspicious rumors of a pending coup attempt. Once outside N'Djamena, the roadbeds in the south are sand and, if it is raining, there are strategically located gate barriers about every 10km which are immediately closed until the road becomes dry enough to permit travel. During the rainy season a traveler must be prepared to be stranded for an indefinite period by erratic rainstorms. Travel in the south is virtually impossible during August and September as the terrain is inundated.

In 1991, a chance encounter over the identity of an unknown *Crinum* species from Namibia allowed me to become acquainted with Darrel Plowes, a naturalist photographer and succulent enthusiast from Zimbabwe. Soon thereafter, Darrel and his wife, Anita Mackey, departed for an assignment in N'Djamena. Anita, a public health specialist, was employed with U.S.A.I.D., and she was selected to help administer our country's resources in Tchad. During their tour in N'Djamena I was fortunate to be their guest on two occasions: ten days in July, 1992, and seven days in July, 1993. Thanks entirely to the efforts of these two wonderful and hospitable individuals, I was provided with the opportunity to study indigenous *Crinum* in southern Tchad and the extreme northern portion of neighboring Cameroun. Anita's diplomatic expertise was a major asset; without her influence and that of her staff at U.S.A.I.D., I would never have passed beyond the military perimeter surrounding N'Djamena.

The highlight of the 1992 trip was a five day sojourn to Sahr in southeast Tchad, about 550km from N'Djamena. For most of the journey the highway paralleled the Chari River, a major river which empties into Lake Tchad, and likely we never passed beyond the river's flood plain. We traveled in a caravan of three U.S.A.I.D. vehicles, each with an experienced local driver. Scarcely had we departed when a rainstorm suddenly appeared, and we spent nearly four hours in a priest's cottage next to a foreboding gate barrier. The storm was brief and soon we were on our way, each of us praying that no more rain was in store. En route to Sahr, most of the terrain was relatively flat and disturbed from primitive agriculture,

but fortunately the ox-drawn plow is a shallow digging tool and doesn't destroy deep-growing bulbous plants. The rains had been abundant though, and I saw many *Crinum* blooming. Because of the rain delay, it was after dark as we neared Sahr. Abruptly we were forced to stop at a military blockade. The colonel in charge was inebriated, not to mention angry and arrogant, and he was determined to apprehend us and to make us sleep on the floor in his outpost hut until matters could be straightened out in the morning. Since all the ensuing dialogue occurred in French, I could not decipher the fine details, but the negotiations were hot and heavy. Although Anita was the ranking official, she had remained silent throughout the initial exchanges because Africa is a male-dominant culture where women have little voice, but finally she could not tolerate it any longer and gave the startled colonel a chastising in perfect French...we soon arrived in Sahr. The following day, arrangements were made quickly with local authorities to hire a forestry officer as guide and a forestry worker as helper, and then Darrel and I spent three days in the field pursuing *Crinum*. (Darrel also added to his butterfly collection.) Once off the main highway, we were soon in areas of undisturbed ecology, and the timing with the rainy season was perfect—many bulbs were blooming and many others had bloomed and were in fruit. Our daily sorties were confined to within 100km of Sahr. We had planned to visit Lake Iro about 200km north of Sahr one day, but the appearance of an afternoon thunderstorm chased us back toward Sahr.

In 1993, Darrel and I traveled in the far northern region of Cameroun for four days. Again, the timing with the rainy season was good, and we saw many *Crinum* in bloom and in fruit. Travel in Cameroun was more relaxing as we only encountered a single military checkpoint, the roads were in better condition and travel papers were not required. English was even spoken in the hotels. We spent enjoyable evenings at the encampment outside Waza National Park and at Hotel le Sare in Maroua. The climate and ecology were similar to southern Tchad until we crossed into the extreme northwest sector about Mokolo—here there was hilly, rocky terrain and rocky, sandy soils, and here lived a different culture, the Matakam peoples and their huts with slender pointed roof-tops. Upon returning to N'Djamena, Anita joined us and we set out to see Lake Tchad. En route we passed one of the rare rocky outcroppings in southern Tchad, and here, in 40+ C heat, was a thriving business: native peoples sitting in squalid huts and mechanically pounding rocks into gravel with hammers, the end product to be sold to pave private driveways in N'Djamena. We drove in the direction of Lake Tchad for hours, beyond any road and clearly onto the dried bed of the lake, but eventually we became discouraged and turned back without ever seeing water.

BACKGROUND

Accurate classification of *Crinum* is a tedious endeavor. Many species bear remarkable similarity in herbaria, and it is impossible to devise a taxonomic scheme based solely upon herbaria. Field investigations are paramount, not only to appreciate the variability found under different ecological conditions, but also to visualize true, three-dimensional configurations and to examine the structure and texture of the leaves. In many species, major classification determinants are fruit, seed, and bulb morphologies, all of which are usually absent or woefully represented in herbaria, illustrations, photographs, and published accounts. Some species are so incompletely described that agreement among investigators over a particular identity may be unrealistic.

The most thorough study of West African *Crinum* was compiled by Chevalier (1950), who traveled throughout the region and observed many bulbs *in vivo*; he collected many herbarium specimens, provided commentary on habitat and local customs regarding plant use, and published several new species. I regarded Chevalier's study as the authoritative work, although it required modification because: 1. Fruit and seed characteristics were lacking except for *C. glaucum* A. Chev.; 2. There were several rule violations regarding date of first publication and synonomy; 3. A cultivated hybrid was designated a species; and 4. One species, *C. pauciflorum* Baker, was erroneously described. In deciphering proper identities, Herbert's discussions about differentiating species proved invaluable. Herbert, whose observations focused upon living plants, provided helpful clues on several species which he cultivated in his hothouse; *C. yuccaeides* (Thompson) Herb., *C. broussonetii* (Redouté) Herb., and *C. distichum* Herbert. Regarding Herbert's descriptive comments: 1. *C. broussonetii*—leaves distinctly undulating, although less so in cultivation, and bulbs with red color at the base; 2. *C. yuccaeflorum* Salisbury—a large variety of *C. broussonetii*; and 3. *C. yuccaeides*—leaves not undulating, margins nearly smooth, and no red coloration at the bulb base. Herbert also felt that a specimen in the Banks Herbarium (erroneously) designated as *Amaryllis ornata* L.f. in Aiton was the same as *C. broussonetii*; the specimen depicted a leaf which was ensiform in configuration. Other botanists whose works I consulted were Baker, Hepper and Nordal. The classification scheme presented is limited to those species which I examined in the field.

CRINUM SUBGENUS *CODONCRINUM*

1. Sessile, tulip-shaped flowers with pure white segments; leaves glaucous; umbel 7-10 flowered.....*C. glaucum*
1. Sessile, funnel-shaped flowers with dark red stripes on segments; leaves not glaucous.....2

2. Leaves broadly channeled, with a midrib, rosulate.....3
2. Leaves deeply channeled/U-shaped, lacking a midrib, rosulate or distichous.....6

3. Leaves <13mm wide, margins smooth; umbel 1, rarely 2 flowered .....*C. humilis*
3. Leaves >40mm wide, margins scabrous.....4

4. Bulbs multiplying vegetatively; leaves lanceolate; fruit abortive; umbel 1-6 flowered.....Hybrid A
4. Bulbs solitary; fruit bearing smooth seeds stacked in vertical columns.....5

5. Leaves ensiform, bearing prominent longitudinal nerves lacing cross striations, containing thick wooly fibers when torn apart; umbel 2-7 flowered.....*C. broussonetii*
5. Leaves lanceolate, bearing slender longitudinal nerves with cross striations, containing thin wooly fibers when torn apart; umbel 4-8 flowered.....*C. yuccaeides*

6. Leaves rosulate, margins denticulate, containing thin wooly fibers when torn apart; umbel 1-3, rarely 4 flowered.....*C. pauciflorum*
6. Leaves distichous, margins denticulate, containing thick wooly fibers when torn apart; umbel 1-3, rarely 4 flowered...*C. distichum*

1. ***Crinum glaucum*** A. Chevalier.
Bull. Soc. Bot. France (Mem.) 2(8):212, 1912, and **Rev. Int. Bot. Appl. Agric. Trop.** 30:623, 1950. Hepper, **Fl. W. Trop. Africa**, ed.2, 3:136, 1968. Nordal and Wahlstrom, **Adansonia** 20:185-186, 1980.

Type: **Benin**: near Save, **A. Chevalier #23581**, 5/6/1910, P.

Bulb ovoid, multiplying to form clumps, 100-200mm diameter, covered with a white papery tunic; leaves rosulate, erect to suberect, not undulate, stiff, almost succulent, 100mm wide, glaucous; scape 600-1200mm long; spathe valves enveloping the perianth tubes at anthesis; umbel 7-10 flowered; flowers zygomorphic, tulip-shaped, sessile, vanilla scented; perianth segments pure white; fruit ovoid with a long apical projection to 150 mm, green turning pale at maturity; seeds large green ellipsoids, few per fruit.

Sightings: **Tchad**: Sahr: 5km NW on main road to N'Djamena.

Unfortunately the only location where this species was sighted (Fig. 8) lay within view of armed sentinels posted in the periphery of a military encampment. Having already experienced one unpleasant encounter with the local military authorities, we conducted our examination in haste so as not to provoke an investigation into "suspicious activities".

2. ***Crinum humilis*** A. Chevalier.
Rev. Int. Bot. Appl. Agric. Trop. 30:610-625, 1950. Hepper, **Fl. W. Trop. Africa**, ed.2, 3:136, 1968. Nordal and Wahlstrom, **Adansonia** 20:190-191, 1980.

Type Specimen: **Burkina**: between Fada-Ngourma and Koupela, A. Chevalier #24530, 7/26/1910, P.

Bulb ovoid, sometimes multiplying vegetatively, 30-50mm diameter, covered with a thin brown papery tunic; bulb scales breaking up into vertical wire-like fibers about the neck; leaves rosulate, suberect, not undulate, slender, <13mm wide, containing minute wooly fibers when torn apart, with smooth margins; midrib narrow; scape 40-135mm long; spathe valves erect, not stiff, enveloping the perianth tube at anthesis, persistent into fruit; umbel 1-, rarely 2-flowered; flowers zygomorphic, funnel-shaped, sessile, scented; perianth segments with dark red stripes; fruit ovoid with a short apical projection 3-10mm long, shiny green turning reddish brown at maturity; seeds smooth, compressed like coins in 3 double columns, 24-72 per fruit.

Sightings: **Cameroun**: Maroua: 1, 7, and 27km E on road to Yoldeo, 12km S on road to airport.

The bulb scales of this species exhibit a peculiar pattern of breaking up into vertical wire-like projections about the neck. Histological examination reveals that the periderm is discontinuous in the region of the bulb neck; the vertical projections represent columns where periderm is formed and these columns appear as separate entities when the intervening bulb scale decays in the region of the neck. One bulb scale thus forms multiple projections.

Controversy surrounds the correct botanical epithet for this species. Lebrun and Stork (1987) have supported Hannibal's (1972) contention that *C. humilis* A. Chev. conflicts with *C. humile* Herb. (1826); they claim that Chevalier erred by selecting the wrong gender (feminine/masculine) for the adjective "humilis" when he combined it with the third declension, neuter gender "Crinum". Since Article 23.5 of the **International Code of Botanical Nomenclature** requires that specific adjectives grammatically agree with the gender of the generic name, then *C. humilis* A. Chev. must be corrected to *C. humile* A. Chev., and this would conflict with *C. humile* Herb. and therefore be an illegitimate epithet according to Art. 64.1. These authors have supported *C. nubicum* (A. Chev.) Hannibal as the legitimate botanical name.

However, botanical epithets need not always be adjectives in the nominative case; they can also be nouns in the genitive case. The noun "humile" is declined in the third declension and possesses neuter gender. If Chevalier combined "Crinum" with the

noun "humile" in the genitive case when he selected his epithet, the result would be *C. humilis*! Why assume that Chevalier made a mistake in gender, when his specific epithet is perfectly acceptable as a genitive noun? According to Recommendation 23A.2, authors should avoid selecting both the nominative and genitive forms of the same word when designating specific epithets in a genus, but an action contrary to a "Recommendation" cannot be cited as grounds for rejecting a botanical name (Preamble 5.).

The published accounts declaring *C. humilis* A. Chev. a "nomen illegitimum" are not valid arguments since *C. humilis* is grammatically a proper botanical epithet. However, is *C. humilis* A. Chev. a legitimate name? At issue is Art. 64.3: are the spellings of *C. humilis* A. Chev. and *C. humile* Herb. so similar that they would likely be confused? If so, then *C. humilis* A. Chev. could be considered a later homonym and declared illegitimate. Numerous examples are listed under Art. 64.3 for guidance, but the answer is arbitrary. Before *C. humilis* A. Chev. could be declared illegitimate with this reasoning, a request asking for a decision would need to be submitted for consideration before the General Committee.

3. (Cultivated) **Hybrid A.**
Chevalier (as *C. scabrum*), **Rev. Int. Bot. Appl. Agric. Trop.** 30:618, 1950. Wahlstrom and Laane (as *C. zeylanicum* in part), **Hereditas** 91:183-206, 1979.

Bulb ovoid, multiplying vegetatively to form large clumps, 65-130mm diameter, covered with a thin brown scaly tunic; leaves rosulate, arching, sometimes weakly undulate, lanceolate, 45-70mm wide, bearing closely spaced longitudinal nerves with fine cross striations, containing thin wooly fibers when torn apart, with minutley serrated margins; midrib a depressed rounded ventral cord with mildly thickened proximal walls; scape 210-330mm long; spathe valves beginning to spread at anthesis, not stiff, decaying in fruit; umbel 1-6 flowered; flowers zygomorphic, funnel-shaped, sessile, unscented; perianth segments with dark red stripe; fruit abortive.

Sightings: **Tchad**: Common on main road from N'Djamena to Sahr, and especially common between Okono and Mogo. Sahr: 7, 10, and 32km E on road to Moussafoyo. Kyabe: locally common.

Cameroun: Waza: 25, 45, 74, 81, and 102km S on road to Maroua. Maroua: 4, 7-8, 11, and 15km E on road to Yoldeo; 37km W on road to Mokolo.

The origin of this hybrid is unknown, but it is common in disturbed soils among previously and currently inhabited agrarian

dwellings and communities. It is readily recognized because it vegetatively forms large clumps of 20-50 bulbs, and the clumps are always solitary because the hybrid is seed sterile. (In contrast, *C. broussonetii* and *C. yuccaeides* do not multiply vegetatively.) This hybrid has special cultural significances among the black African peoples of southern Tchad, and its widespread distribution owes to semi-nomadic practices of moving to areas of richer soils. The bulb is regarded as possessing magical properties which protect a home and property from evil spirits when planted nearby. (Chevalier commented that the plant was regarded as a fetish by local natives.) Although the flowers of this hybrid are indistinguishable compared to those of *C. broussonetii* and *C. yuccaeides*, the latter species are not in obvious cultivation in Tchad. In northern Cameroun, the same clumped hybrid is sporadically found in disturbed land, and in the region of Maroua, it is sometimes employed as a boundary marker. Most bulbs in a clump bloom simultaneously early in the rainy season, which is an impressive sight (Fig. 4). This sterile hybrid should correlate with the triploid ($3n$=33) bulbs from north central Cameroun described by Wahlstrom and Laane (1979).

4. ***Crinum broussonetii*** (Redouté) Herbert.
Amaryllis broussonetii Redouté, **Les Liliacées**, V.2, t.62, 1805.
Herbert, **Bot. Mag**. t.2121, 1820, and **Amaryllidaceae**, p.260, 1837.
Chevalier (as *C. sanderianum*), **Rev. Int. Bot. Appl. Agric. Trop.** 30:616, 1950.
Syn.: *C. yuccaeflorum* Salisbury, **Par. London.**, t.52, 1806.
C. sanderianum Baker, **Gard. Chron.** 22:102, 1884. **Amaryllideae**, p.90, 1888 and **Fl. Trop. Africa** 7:400, 1898.
C. ornatum sensu Hepper, **Fl. W. Trop. Africa**, ed.2, 3:134, 1968.
C. zeylanicum sensu Nordal and Wahlstrom (in part), **Adansonia** 20:186-188, 1980.

Type Figure: **Les Liliacées**, V.2, t.62, 1805.

Bulb ovoid, solitary, 70-160mm diameter, covered with a thick brown papery tunic; leaves rosulate, arching, distinctly undulate, ensiform, 50-75mm wide, bearing closely spaced prominent longitudinal nerves lacking cross striations, containing coarse wooly fibers when torn apart, with serrated margins; midrib a V-shaped ventral keel with prominent thickened proximal walls; scape 200-310mm long; spathe valves erect, stiff, enveloping the perianth tubes at anthesis, decaying in fruit; umbel 2-7 flowered; flowers zygomorphic, funnel-shaped, sessile, unscented; perianth segments with dark red stripes; fruit ovoid, umbilicate or bearing a short apical projection to 8mm long, shiny green turning shiny dark red at maturity; seeds smooth, stacked in 6 vertical columns, compressed if numerous, 16-50 per fruit.

Sightings: **Tchad**: N'Djamena: 10km N on road to Abeche, 7km E on road to Linia, and 30, 45, 56, 59, 69, 75 and 101km SE on road to Abba-Liman. Okono: locally endemic. Bailli: 13 and 23km NW on road to Okono. Mogo: 10km SE on road to Sahr. Sahr: 34km E on road to Moussafoyo, 12km N on road to Kyabe, and 15km NW on road to Mogo.

Cameroun: Waza: 33, 84, 107 and 119km S on road to Maroua. Maroua: 27-28km E near Yoldeo, 11-15km S on road to airport. Mokong: 14-15km E on road to Maroua.

Leaves provide the distinguishing characteristics between *C. broussonetii* and *C. yuccaeides*. Leaf contour differences include: *C. broussonetii*—leaves widest at the base, gradually tapering to a long slender point (ensiform), and exhibiting prominent undulations except when afforded with excessive moisture (inundated conditions) such as can happen in cultivation; *C. yuccaeides*—leaves widest in the middle (lanceolate), comparatively shorter and tapering to a less acute point than the former, and lacking undulations except during very dry conditions (see Fig. 3). Leaf construction differences include: *C. broussonetii*—thicker, sturdier leaves containing coarse white wooly fibers when torn and prominent, closely spaced horizontal nerves, but which do not exhibit horizontal nerves (cross striations) when viewed via transmitted light *in vivo*; *C. yuccaeides*—thinner leaves containing thin white wooly fibers when torn, small longitudinal nerves, and which exhibit a delicate pattern of horizontal nerves when viewed via transmitted light *in vivo*. When mature leaves from bulbs of similar diameter are compared, those of *C. broussonetii* are narrower and approximately 50% longer than those of *C. yuccaeides*. Also, the midrib of *C. broussonetii* appears as a V-shaped ventral keel, while the midrib of *C. yuccaeides* possesses a rounded ventral contour. In cultivation, seedlings of comparable age are easily distinguished: *C. broussonetii*—arching V-shaped leaves with dark red pigment in the leaf bases and bulb neck; *C. yuccaeides*—shorter, broadly-channeled spreading leaves lacking red pigment in the leaf bases and bulb neck (see Herbert's comments above).

Although much of the ecology had been disturbed in southern Tchad and northern Cameroun, these two species appeared to occupy different habitats. *Crinum broussonetii* inhabited the open, flat savannah regions where temporary conditions of inundation could occur. In contrast, *C. yuccaeides* was found along the banks of (temporary) streams and small rivers. Following the initial saturating rainfall at the onset of the rainy season, scapes emerged from the ground at the same time as the leaves in *C. broussonetii*; unfortunately no observations of similar timing with initial rainfall were made regarding *C. yuccaeides*.

5. ***Crinum yuccaeides*** (Thompson) Herbert.
Amaryllis yuccaeides Thompson, **Botany Displayed**, n.4, t.14, 1798. Herbert, **Bot. Mag.** t.2121, 1820, **Appendix**, 1821, and **Amaryllidaceae**, p.260, 1837. Chevalier (as *C. yuccaeflorum*), **Rev. Int. Bot. Appl. Agric. Trop.** 30:622, 1950.
Syn.: *C. zeylanicum sensu* Nordal and Wahlstrom (in part), **Adansonia** 20:186-188, 1980.

Type: **Botany Displayed**, n.4, t.14, 1789.

Bulb ovoid, solitary, 70-140mm diameter, covered with a thick brown papery tunic; leaves rosulate, arching, sometimes weakly undulate, lanceolate, 60-120mm wide, bearing closely spaced longitudinal nerves with cross striations, containing thin wooly fibers when torn apart, with minutely serrated margins; midrib a depressed rounded ventral cord with mildly thickened proximal walls; scape 160-280mm long; spathe valves erect, not stiff, enveloping the perianth tubes at anthesis, decaying in fruit; umbel 4-8 flowered; flowers zygomorphic, funnel-shaped, sessile, unscented; perianth segments with dark red stripes; fruit ovoid, umbilicate or bearing a short apical projection to 5mm long, shiny green turning dark red at maturity; seeds smooth, stacked in 6 vertical columns, compressed if numerous, 3-50 per fruit.

Sightings: **Cameroun**: Waza: 13km NE on road to Kousserie, and 40km S on road to Maroua. Mokolo: endemic on road to Mogode.

Chevalier chose *C. yuccaeflorum* as the botanical name of this species, but I believe that *C. yuccaeides* is preferable for the following reasons: 1. Herbert identifies *C. yuccaeflorum* as a large variety of *C. broussonetii*, whereas he cites observable differences between *C. yuccaeides* and *C. broussonetii* which have correlated with my observations; 2. Salisbury's illustration of *C. yuccaeflorum* depicts a distinctive network of closely spaced longitudinal nerves on the adaxial leaf surface similar to the prominent nerves of *C. broussonetii*, whereas the longitudinal nerves in this species are not conspicuous on the adaxial leaf surface; and 3. *Crinum yuccaeides* (as *A. yuccaeides*) has priority of publication date over *C. yuccaeflorum*.

6. ***Crinum pauciflorum*** Baker.
Journ. Bot. 7:195, 1878, **Amaryllideae**, p.88, 1888, and **Fl. Trop. Africa** 7:399, 1989.

Type Specimen: **Sudan**: Djur, Seriba Ghattas (Bahr El Ghazal District, approximately 50km SE of Wau), Schweinfurth #1975, 6/23/1869, Ex Museo Botanico Berolinense, K!.

Bulb ovoid, solitary, 40-50mm diameter, covered with a thick dark-brown papery tunic; leaves rosulate, long and arching, deeply channeled/U-shaped, <25mm wide, containing thin wooly fibers when torn apart, with denticulate margins; lacking a midrib; scape 340-500mm long; spathe valves erect, not stiff, enveloping the perianth tubes at anthesis, decaying in fruit; umbel 1-3, rarely 4-flowered; flowers zygomorphic, funnel-shaped, sessile, scented; fruit irregular ovoid or elongated, umbilicate or bearing a short apical projection to 5mm long, shiny green turning dark reddish-purple at maturity; seeds smooth, compressed and arranged in columns when numerous, 10-60 per fruit.

Sightings: **Tchad**: Sahr: 51 and 64km N on road to Kyabe, 32 and 34km E in remote properties of sugar cane plantation. Guelendeno: 12km NW near culvert #49.

The validating description for this species was based solely upon examination of herbaria; no commentary was provided concerning living plants or habitat. It remained an obscure bulb until Chevalier (1950) provided his accounting. However, Chevalier erred and confused this species with *C. distichum*, for he described the leaves as being distichous. Hepper (1968) and Nordal (1979) subsequently reduced *C. pauciflorum* to synonomy with *C. distichum*, having been influenced by Chevalier's report.

This species differs from *C. distichum* in two major categories: 1. Its leaf arrangement is rosulate, not distichous; and 2. Its leaves possess weak wooly fibers, not coarse wooly fibers. The latter accounts for a decided difference in herbaria between these two species. When a bulb of *C. pauciflorum* is dug in the morning, by late afternoon its leaves are flaccid and limp; it is then possible to flatten the U-shaped leaf contour in a plant press so that a long, slender, almost linear pattern is produced. In contrast, when a bulb of *C. distichum* is dug, its leaves remain sturdy and distinctly U-shaped for days; it is not possible to flatten mature leaves in a plant press without fracturing them. Leaves of *C. distichum* in herbaria appear as though they are folded longitudinally.

The habitats of *C. pauciflorum* and *C. distichum* also differ. *Crinum pauciflorum* occurs in seasonal ponds with a clayish soil base (Fig. 5), and these ponds are 1-2m deep in the center with the bulbs scattered in the shallows of the periphery. In contrast, *C. distichum* grows in marshy grass flats which course through the savannahs; 50-200mm of standing water is common in these flats late in the rainy season; the soil is silty sand, and when inundated, small bulbs can be plucked by hand from the moist soil. *Crinum distichum* does not require standing water to bloom, and it blooms earlier in the rainy season than does *C. pauciflorum*. When cultivat-

Fig. 1. *Crinum humilis* A. Chev., 12km south of Maroua, Cameroun. July 17, 1993.

Figure 2. *Crinum broussonetti* (Redouté) Herb. 7km east of N'Djamena, Tchad. July 14, 1992.

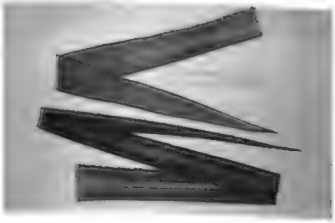

Fig. 3. Leaf comparison: *Crinum yuccaeides* (lanceolate; upper, adjacent to ruler) versus *Crinum broussonetti* (ensiform; lower).

Fig. 4. (Cultivated) *Crinum* Hybrid A. 25km south of Waza, Cameroun. July 16, 1993.

Fig. 5. Habitat of *Crinum pauciflorum* Baker, 12km northwest of Guelendeno, Tchad. July 15, 1992.

Fig. 6. *Crinum pauciflorum* Baker. Bulbs collected in southeast Tchad and cultivated by the author.

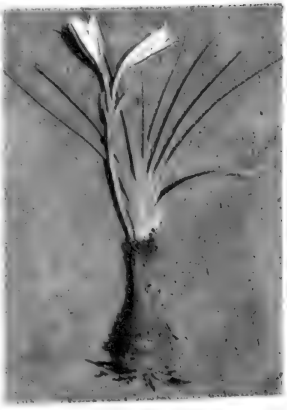

Fig. 7. *Crinum distichum* Herb. 6km northwest of Sahr, Tchad. July 7, 1992.

Fig. 8. *Crinum glaucum* A. Chev., 5km northwest of Sahr, Tchad. July 7, 1992.

ed under the same conditions in galvanized tubs, *C. distichum* blooms 1-2 months before *C. pauciflorum*.

7. ***Crinum distichum*** Herbert.
Specierum Enumeratio in **Bot. Mag**. t.2121, 1820, **Appendix**, 1821, and **Amaryllidaceae**, p.260, 1837. Baker, **Amaryllideae**, p.89, 1888. Chevalier, **Rev. Int. Bot. Appl. Agric. Trop**. 30:618, 1950. Hepper, **Fl. W. Trop. Africa**, ed.2, 3:136, 1968. Nordal and Wahlstrom, **Adansonia** 20:188-190, 1980.

Type Figure: **Bot. Mag**. t.1252, 1810.

Bulb ovoid, solitary, 40-75mm diameter, covered with a thick brown papery tunic; leaves distichous, arching, spreading in a fan-shaped array, deeply channeled/U-shaped and stiff, <25mm wide, containing thick wooly fibers when torn apart, with denticulate margins; lacking a midrib; scape 100-230mm long; spathe valves erect, stiff, enveloping the perianth tubes at anthesis, persistent in fruit; umbel 1-3, rarely 4 flowered; flowers zygomorphic, funnel-shaped, sessile, scented; perianth segments with dark red stripes; fruit globular or elongated with a short apical projection to 5mm long, shiny green turning shiny reddish-purple at maturity; seeds smooth, irregular, compressed when numerous, 3-50 per fruit.

Sightings: **Tchad**: Abba-Liman: locally endemic. Guelendeno: 6, 8, and 21-22km NW on road to Abba-Liman. Ba-illi: 18 and 20km NW on road to Okono, and 13, 19-23, and 29km SW on road to Mogo. Sahr: 6, 13, 32, 106, and 109km NW on road to Mogo, 37, 38, 52-58, 62, 66-67, and 70km N on road to Kyabe, and 29km E on edge of sugar cane plantation.

Crinum distichum (Fig. 7), endemic throughout much of southern Tchad, sometimes occurs in vast seas of bulbs. In disturbed land it manages to survive reasonably well in the face of the ox-drawn plow. Bulbs frequently bloom more than once during the rainy season, and finding one in fruit and in bloom at the same time is common. Kammacher and Assi (1975) report that *C. distichum* has a reduced number of chromosomes, $2n=20$, instead of the usual $2n=22$.

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THE RETICULATA IRISES

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The so-called "retics" represent one of the three groups of bulbous iris which can be identified as follows:

- Bulb with fleshy roots persisting in the resting time, inner tepals small, horizontal or drooping; about 60 species, all Asian except one.....Scorpiris (Juno)
- Bulb without persistent roots, inner tepals well developed, erect:
  - ➤ smooth, membranous outer coats (tunics), floral stem >30cm; Western Mediterranean; 7-8 species.....Xiphium
  - ➤ netted outer coats, stem <20cm or absent; Asia; 10 species.....Reticulata

There is debate as to whether the bulbous species are, taxonomically speaking, "true" *Iris* or not. G. Rodionenko (1961) has upheld each of the three groups to a generic status, namely *Iriodictyon* [Greek *dictyon*=net), *Scorpiris* (Juno) and *Xiphion*, whereas they were classified by B. Mathew (1981) as subgenera—*Hermodactyloides*, *Scorpiris* and *Xiphium*—of the genus *Iris*. Incidentally, a former attempt to accomodate the "retics" had been made by Alefeld (1863), who had purposely created the genus *Neubeckia*.

Whatever the name—*Iridodictyon, Hermodactyloides* or (more commonly) *Reticulata* (Latin *reticulatus*=net)—this small group of some ten species is characterised by the fibrous netted outer coats of the bulb, the stemless, single, long-tubed flower (all species but one), the peculiar feature of the several-ribbed leaves, not unlike *Hermodactylus tuberosus* (the snake head iris), a monotypic genus closely allied to *Iris*. Retics are, as all bulbous irises, geophytes; they flower in winter or early spring, have a summer dormancy broken by autumn rains and colder temperatures that initiate the sprouting of new roots.

Cultivation is not difficult in a limey, well drained soil and a sunny location. These tiny plants are well adapted to the rock garden provided that it gently dries out in summer. The seeds, freely produced, germinate readily if sown in fall and seedlings will take 3-5 seasons to reach flowering size. Side bulblets are produced often which allows faster multiplication. They are also valuable additions to the winter-spring garden due to their early and striking flowers. They are healthy items as a rule, just keep slugs and snails under control as they are very fond of the floral buds. The bulbs are sensitive to the "ink disease" caused by the fungus *Mystrosporum adustum* (*Drechslera iridis*): the foliage is suddenly wilted, the bulbs showing black streaks and patches on the tunics, and the leaf bases and plants eventually dying.

Key to the Reticulata irises:

1. Leaves linear, channeled. Central Asia
   2. Outer tunics netted.....*I. kolpakowskyana*
   2' Bulb devoid of any netted coat.....*I. winkleri*
1' Leaves tubular in section, 4 (or 8) ribbed. Asia Minor
   3. Leaves 8-ribbed, almost cylindrical (terete).....*I. bakeriana*
   3' Leaves 4-ribbed, square in cross section
      4. Inner tepals (standards) vestigial.....*I. danfordiae*
      4' inner tepals well developed
         5. Leaves poorly developed at anthesis
            6. Flowers large, tepals held flat (like a *Clematis*)
               7. Flowers violet. Turkey.....*I. histrioides*
               7' Flowers yellow. Transcaucasia.....*I. winogradowii*
            6' Flowers medium-sized, erect tepals.....*I. reticulata*
         5' Leaves well developed at anthesis
            8. Floral peduncle present, pendant pod. S. Turkey
               .....*I. pamphylica*
            8' Acaulescent (stemless) plants, erect, ground-lying pod
               9. Style crests >style branches, early flowers (Dec.-Jan.).....*I. vartani*
               9' Style crests <style branches, later flowering (Feb.-Mar.).....*I. histrio*

Mathew has further (1989) divided the group into four sections:

Brevituba: includes *I. pamphylica*
Micropogon: includes *I. danfordiae*
Monolepis: includes *I. kolpakowskyana* and *I. winkleri*
Hermodactyloides: all the other species

All have a chromosome number of $2n=20$, except for *I. danfordiae* ($2n=18$), *I histrioides* ($2n=16$) and *I. winogradowii* ($2n=16$).

SECTION *HERMODACTYLOIDES*

Iris bakeriana Foster (1889) is easily distinguished by its almost terete leaves, barely 8-ribbed with an almost round cross section. It is a montane species (900–2000m) of southeast Turkey, northeast Iraq and western Iran, often flowering near melting snow. The two leaves are 10-15cm tall at flowering time but eventually elongate up to 20–25cm before dying down in late spring. Flowers are very striking, the outer tepals (falls) pale blue with some darker veins along the haft (claw) and a large deep velvety purple-blue blotch on the blade, 4-5cm long. Inner tepals (standards) erect, nearly as long as the outer ones, lilac-blue. The fruit (pod) is erect and held at ground level.

Iris histrio Reich. f. (1872) was the second species to be describ-

ed after *I. reticulata*. It is native to the Eastern Mediterranean from southern Turkey to Lebanon, Syria and northern Israel at up to 1000m altitude. At flowering time (late January to early March) plants are 12-18cm tall but foliage may grow to 40cm. The long-tubed (8-12cm) flowers have a pale pearly to sky-blue basic color, the blade of the large (6cm) falls is heavily mottled and blotched deep violet with a conspicuous yellow median ridge. That may explain the specific name *histrio* which means "clown" in Latin. To me, this is the most beautiful of all the retics. This species seems to be very resistant to the ink disease, as is *I. vartani*, described below.

Iris histrio subsp. *aintabensis* has smaller, less blotched flowers and is from a small area of southern Trukey (Gaziantep).

Iris histrioides G.F. Wilson (1892) is as tall as *I. histrio* but has a more northerly origin (central Turkey near Amasya where it is found 1300–1800m altitude). The leaves are scarcely visible at anthesis. Flowers are large, up to 12cm across in var. *major*, deep blue with a few patches around the median yolk-yellow ridge. All segments are held semi-erect, giving flowers a flattish appearance. The flowers in February and March often pierce the snow. *Iris histrioides*, despite its fairly local occurrence, has become popular due to its hardiness. Crossed with *I. reticulata*, it has produced interesting hybrids.

Iris reticulata Bieberstein (1808) was the first described in the group and is the most widely distributed (eastern Turkey, Caucasus and Transcaucasia, northern and northwestern Iran, northeast Iraq, from 600 to 2700m altitude). It has the largest colour range—from whitish to any shade of blue, violet and purple (including reddish in var. *krelagei*) often highlighted by a yellow to orange median ridge. Some forms are sweetly scented of violets. Flowers are 6–8cm across and open from February to April, according to the altitude. This species is very hardy and easy in cultivation.

Iris hyrcana, at times held as a "good" species, is merely a form of *I. reticulata*.

Many selected varieties and hybrids, chiefly of Dutch origin, are available in the trade. *Iris reticulata* appears to hybridize with *I. bakeriana, I. histrioides* and even *I. danfordiae* (A. McMurtrie, pers. comm.).

Iris vartani Foster (1885) is rarely seen due to its remote and "politically sensitive" native haunts—southern Lebanon, northern Israel and Jordan, and southwest Syria. It overlaps the southern part of distribution of *I. histrio* but is of a more inland, higher area up to 1500m, and of drier occurrence. It is clearly identified by its narrow style crests, longer than the style arms which overtop slatey-

mauve falls provided with some darker veins and a median yellow ridge. The smaller standards and styles are faintly veined too. The flowers gives off a sweet scent of almonds. The leaves are fairly developed at flowering time which takes place early in winter (December-January). This species stands blistering summer heat *loco natali* and dislikes any excess of moisture at any time, so it is suitable for hot Mediterranean climates like Southern California.

Iris vartani var. *alba* which appeared in the trade some years ago remains an enigma; it was never found in the wild and its flowers, though also quite early, are differently shaped. The plant itself is weak and prone to virus.

Iris winogradowii Fomin (1914) is the only other yellow retic along with *I. danfordiae* and is the yellow counterpart of *I. histrioides*. This is a very local species, found only on the slopes of a mountain of Transcaucasia (Lomis Mta, Georgia) where the population is on the verge of extinction, with just a few hundred plants remaining according to Rodionenko. Luckily it is kept in cultivation for now. It has the habit of *I. histrioides* but large pale yellow flowers with a deeper median ridge and a sparse green dappling on the blade of its falls. It blooms somewhat later than *I. histrioides* (March-April) as its habitat is subalpine meadows in an acidic soil which does not dry out in summer. This species does not need to be "baked" in summer as with the other retics. It hybridizes freely with *I. histrioides* (both have the same chromosome number, $2n=16$). The well known 'Katherine Hodgkins' is one of its siblings.

SECTION *BREVITUBA*

A monotypic section accomodating the latest described retic, *I. pamphylica* Hedge (1961), which displays some peculiar features:

- rather fleshy, though non-persistent roots.
- short needle-like hairs at the base of the bulb (reminescent of those found in some non-bulbous distantly related species such as *I. grant-duffii/I. masia.*
- true floral stem (10–20cm), overtopped by a short (2cm) floral tube.
- a nodding capsule at maturity (as in *Hermodactylus tuberosus*).

The flowers are also oddly bicolored: outer tepals have a green, darker spotted claw and a brownish-purple blade with a yellow, purple-stippled median ridge; the inner ones are medium to deep blue, passing to greenish at its base. Flowering time is March to April. This is another species found only in a small area around Antalya, southern Turkey, in scrubland at 700–1500m. This province was known in antiquity as Pamphylia, hence the specific name. It is

unfortunately threatened in the wild due to overcollecting.

SECTION *MICROPOGON*

This section includes just one species, *I. danfordiae* (Bak.) Boiss. (1882), placed there by Mathew on cytological arguments. It is the smallest species (<10cm at flowering time), and is easily recognized by its rich yellow, spotted, dark green obvious outer segments surrounded by wide styles. Inner segments are vestigial or lacking. It is found on the stony slopes of Anatolia, Turkey, at 1000–2000m altitude, where it flowers in February and March. The four-ribbed leaves are up to 20cm long when fully grown.

The bulbs sold in the trade are of a triploid, sterile form with larger flowers (5–6cm across) which have the drawback of splitting into a "spat" of rice-grain bulblets which take several seasons to reach flowering size. A deep planting sometimes suggested to overcome this defect does not seem very effective. The wild diploid form, though smaller, is freely blooming every year and sets seeds.

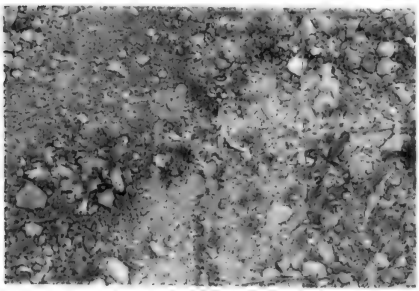

Photo above: *Iris bakeriana* is on the left, *Iris danfordiae* is in the center and *Iris reticulata* is on the right.

Iris histrio

Photos: Maurice Boussard

SECTION *MONOLEPIS*

According to Rodionenko this section harbours 1-2 centro-Asian species identified by linear, canaliculate (channeled), non multi-ribbed leaves having a pale median stripe on the upper part (not unlike *Crocus*) and entire, not bilobed stigmas. These species are also outliers in geographical distribution, some 2000km east of

the other species. Some computations have been made upon its origin, with a Juno or even a *Crocus* as a possible parent, since they share some features and grow sympatrically with *C. alatavicus* and *I. rosenbachiana.*

I. kolpakowskyana Regel (1877). 15–20cm tall with 3–4 linear leaves well formed at anthesis. Flowers are carried on a tube 6–10cm long and vary from lilac to violet with a deep purplish violet blade of falls. Flowering period is March to April. From the Tian-Shan Mountains of central Asia at altitudes up to 2000m, at times blooming at snow limits.

I. winkleri Regel (1884). A dubious species, this is known only from a herbarium specimen housed at St. Petersburg and never collected since. It differs from *I. kolpakowskyana* by the smooth (non-netted) bulb tunics and a higher altitudinal occurrence (3000-4000m). Further collections should disclose the mystery but the remote and high Fergana Mountains from which it is said to come are not to be trodden for quite a while.

In a word, the reticulata irises are dwarf, pretty, brightly coloured and easy-to-grow jewels well adapted to cool climates, while a few species such as *I. histrio, I. pamphylica* and *I. vartani* should thrive in hotter and drier areas.

Iris vartanii

Iris reticulata 'Alba'

FRITILLARIA CHLORORHABDOTA (LILIACEAE), A NEW SPECIES FROM IRAN

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ABSTRACT

Fritillaria chlororhabdota is described as new to science from Iran. The new species belongs to the *Fritillaria caucasica* group, section Olostyleae, subgenus *Fritillaria*, and is related to *F. caucasica* but clearly distinguished by distinctly folded leaves at fruiting time; a median green stripe extending to the apex on the inner side of the tepals; a short, entire, stout and densely papillose style; and reticulate exine of pollen grains. SEM studies of nectaries, stamens, pollen and styles are presented. Differences from other Iranian taxa in the Caucasica group are discussed. The chromosome number is $2n$=24.

Fritillaria chlororhabdota Bakhshi Khaniki, sp. nova

Habitu, numero et positione et forma foliorum, colore externo perianthii F. caucasiacae; ab ea differt foliis tempore fructificandi conduplicatis, perianthio minori anguste campanulato, tepalis interne viridi-fasciatis, nectariis late lanceolatis, stylo brevi integro, pollinis granulis scaberulis reticulatis.

Typus: Iran: Lorestan, Dow Rud, road of Dow Rud to Azna, north of Thiun village, Oshtoran Kuh, 1800m, stony hills heavily grazed by sheep and goats, with *Euhorbia* and *Thymus*, 15 May 1994, G. Bakhshi Khaniki 84 (Holotypus GB). Figures 1 and 2.

Note: living plants of populations collected by the author are cultivated at Göteborg Botanical Garden, Sweden.

Bulb ovoid, up to 1.5cm in diameter; without bulbils or stolons. **Stem** 15–51cm, 12–30 (–45) cm above ground, smooth. **Leaves** 4–7, somewhat glaucous, all alternate, the lowest 5–11 x 1.5–2cm, narrowly oblanceolate to elliptic-oblong, usually folded at fruiting time, the uppermost (bract leaf) 2–5cm long, linear to narrowly lanceolate, acute. **Flowers** 1 (2), narrowly campanulate, perianth segments purplish outside, paler inside with median yellowish-green bands extending to apices, sometimes tinged or sparsely green-dotted towards margins, outer segments 12–16 x 46mm, eliptic-narrowly oblong, obtuse, inner ones 6.5–8mm wide, lanceolate, obtuse. **Nectaries** broadly lanceolate to narrowly elliptic, 2.5–4mm long, placed 0.5–1mm above base of tepals, green. **Filaments** 7–8mm, yellow to brown, stout, glabrous to sparsely papillose at base, densely

papillose in upper part. **Anthers** 5–7mm long before dehiscence, ellipsoid, brown-purplish, basifixed. **Style** 6–8mm, entire, stout, greenish-yellow, densely papillose. **Ovary** three-locular, 8–10mm, stout, usually green. **Capsule** 2.5–3.5 x 1.5–2cm, obovoid, obtuse, tapering toward the base, not winged. **Seeds** flat, ovate in outline, 3.5-5mm long. Flowering April–May.

Western Azarbaijan, Zagros mountains; mountain steppe, alpine pastures, rocky and grassy ledges, 1600-2000m.

SPECIMENS SEEN

Iran: Western Azarbaijan: Umiah to Salmas, Akhordarrah, 1600m, the top area, associated with *Euphorbia, Geranium, Thymus, Tulipa, Anthemis, Gagea* and grasses, 9 May 1995, **G. Bakhshi Khaniki 64** (GB); Urmiah, Sir Kuh, 6000ft., widespread and common on grassy slopes sometimes in clumps or scattered, 8 May 1963, **Mathew *et al.* in BSBE 1433** (K); 25km N of Urmiah, Sir village, Kuh-e Sir, 1800–2000m, in wheat fields with *Poa, Stipa barbata, Fritillaria crassifolia* ssp. *kurdica* and *Tulipa*, 9 May 1995, **G. Bakhshi Khaniki 65** (GB); Kordestan: 40km E of Sanandaj, Slavatabad, alfalfa fields, 1700–1900m, 6 May 1995, **G. Bakhshi Khaniki 66** (GB); Lorestan: Dow Rud, road of Dow Rud to Azna, Rostamghalah, 1800m, clay-loam soil in humid area with tall grasses, 14 May 1994, **G. Bakhshi Khaniki 82** (GB); Khorramabad, 42km W of Azna, 1850m, in wheat fields, 14 May 1994, **G. Bakhshi Khaniki 83** (GB); Dow Rud, road of Dow Rud to Azna, Darband train station, in fields, 16 May 1994, **G. Bakhshi Khaniki 85** GB).

Fritillaria chlororhabdota can be classified in subgenus *Fritillaria*, subsection *Olostyleae* Boiss., and more specifically in the *F. caucasica* group because of its narrowly campanulate flowers and the shape and position of its nectaries.

In Iran, the subgenera of *Fritillaria* from central Asia, the Mediterranean, and Caucasus meet (Rix 1977). Consequently, this may be an important area for diversification and the occurrence of new species. Bornmüller (1930) recorded ten species only from the Zagros mountains belonging to the following subgenera: *Petilium, Theresia, Rhinopetalum* and *Fritillaria*. Three main groups (*F. kotschyana* group, *F. crassifolia* group, *F. caucasica* group) within subgenus *Fritillaria* are represented in Iran. All Iranian species belonging to the *F. caucasica* group are distributed in the Zagros mountain chains and/or Azarbaijan (western and northwestern Iran). Here, six previously described species (Rix 1977, Rechinger 1990, Bakhshi Khaniki 1966) are found belonging to this complex: *F. caucasica* Adams, *F. zagrica* Stapf, *F. atrolineata* Bakhshi Khaniki, *F. assyriaca* Baker, *F. chlorantha* Hausskn. & Bornm. and *F. uva-vulpis* Rix.

Among the Iranian species in the Caucasica complex, *F. chlororhabdota* seems to be closest to *F. caucasica*, by phyllotaxy (shape, number and position of the leaves) as well as shape and external colour (purplish) of the tepals. There are, however, several characters distinguishing *F. chlororhabdota* from this species: folded leaves at fruiting time, narrowly campanulate flowers, obtuse tepals with a median green stripe on the inside; wide lanceolate nectaries; shorter filaments, rough pollen exine with big luminae (reticulate sculpturing type), and an entire stout style. In contrast, *F. caucasica* has flat leaves during the whole of its vegetative period; acute tepals (sometimes inner ones obtuse) that are paler purple inside (sometimes greenish) and without a green stripe along the whole of their length, linear-lanceolate nectaries, longer filaments, smooth pollen exine (knobs are absent) with very small luminae (foveolate sculpturing type), and longer, trilobulate styles.

Fritillaria zagrica, which is confined to the Zagros mountains, is distinguished from *F. chlororhabdota* by its comparatively short stems, pronouncedly glaucous leaves, the lowest sometimes subopposite and with undulate margins, dark purple flowers (outside and inside) with a bright yellow apex, filaments densely papillose all over, and sparsely papillose and narrowly trilobulate styles.

Fritillaria chlorantha is characterised by the presence of bulbils, short stems, broad, shiny green leaves, bright green flowers sometimes marked with purple, much longer filaments, smooth pollen, and styles 3-fid at the apex for 1-2mm. *Fritillaria chlorantha* is confined also to the Zagros mountains.

In *F. assyriaca*, there are 3-12 small bulbils at the base of the bulb at flowering time. Furthermore, it has a papillose stem; linear, canaliculate leaves; elliptic-oblong nectaries; wholly papillose filaments and trilobulate styles. This species is recorded from northwest Iran (provinces W. Azarbaijan, Lorestan, Fars).

Fritillaria uva-vulpis differs from *F. chlororhabdota* by the presence of bulbils; widely spaced, shiny green, narrowly lanceolate leaves; rounded flowers, narrowed at the mouth; perianth segments purplish edged with yellow outside, yellowish inside, and smooth pollen grains. *Fritillaria uva-vulpis* is recorded from only one locality (Western Azarbaijan: Mahabad) in Iran, and is otherwise known from a small area in northern Iraq and southeast Turkey.

As for *F. atrolineata*, which has been recently described as a new species in the *F. caucasica* group by Bakhshi Khaniki (1996a), the presence of subverticillate or subopposite, oblanceolate leaves; yellowish-green to green flowers; linear, black nectaries, foleolate exine of pollen grains, and slightly trilobulate styles separates that species from *F. chlororhabdota*.

Among Turkish species of the same complex, *F. pinardii* is super-

ficially similar to *F. chlororhabdota* because of flower shape and phyllotaxy but differs in the presence of bulblets and sometimes stolons; furthermore in stem pubescence (sometimes papillose below), nectary shape, (linear-lanceolate versus broadly lanceolate to elliptic), sculpturing of pollen exine, and slightly trilobulate style.

Fritillaria armena is another species belonging to the Caucasica complex which does not occur in Iran. It is a native of northeast Turkey, especially around Erzurum, and is distinguished from *F. chlororhabdota* by smaller allover size, tepals dark purplish-brown inside and outside, 3-fid style and different pollen morphology.

Key to the Iranian species of the *Fritillaria caucasica* group

1. Flower broadly campanulate; the nectary at the point of inflection of the tepals (*F. kotschyana* group, *F. crassifolia* group)
1. Flower narrowly campanulate; the nectary at the base or 0.5-2mm above the base of the perianth segments (*F. caucasica* group). .2
2. Style slender, 3-fid 3
2. Style stout, undivided or very slightly trilobulate at apex 5
3. Leaves shiny green . . . . . *F. chlorantha*
3. Leaves glaucous 4
4. Leaves canaliculate, linear, stem often papillate at the base . . . . . *F. assyriaca*
4. Leaves flat, broadly lanceolate to lanceolate, stem without papillae . . . . . *F. caucasica*
5. Perianth segments greenish, nectaries black . . . . *F. atrolineata*
5. Perianth segments usually purplish, nectaries usually green . . .6
6. Leaves shiny green, flowers rounded . . . . . *F. uva-vulpis*
6. Leaves glaucous, flowers narrowly campanulate 7
7. Perianth segments with a median green stripe to the apex on the inner sides . . . . . *F. chlororhabdota*
7. Perianth segments dark purplish inside and outside with a bright yellow apex. . . . . *F. zagrica*

CHROMOSOME MORPHOLOGY

$2n$=24 (Fig. 3a), similar to most other *Fritillaria* species (Darlington 1930, La Cour 1978, Koul & Wafai 1980, Macfarlane 1978, Merchant & Macfarlane 1980, Moore 1982, Kamari 1991, 1993, Zaharof 1989, Basak 1991, Bakhshi Khaniki 1996a). The karyotype consists of two large metacentric, five subtelocentric and five telocentric chromosome pairs (karyotype formula is $2n$=$2x$=24=4m + 10st + 10t; nomenclature for centromeric position according to Levan *et al.* 1963). A haploid idiogram based on the measurements of ten metaphase plate is presented (Fig. 3B). Secondary constrictions were visible also in different plates but varied in number and appearance, two of which (pairs numbers 1 and 8) are shown in the haploid idiogram (Fig. 3B). Some particulars of the karyotype are listed in Table 1.

SEM STUDIES

Nectaries. The nectaries in *F. chlororhabdota* are comparatively wide, lanceolate or elliptic and green. A scanning electron microscopy (SEM) investigation clearly establishes the nectaries to be situated almost at the base of the perianth segments or 0.5mm above (Fig. 4A, B), the usual position for taxa in the *F. caucasica* complex (Rix 1974, 1977, 1984; Turill & Sealy 1980; Bakhshi Khaniki in manus.), and furthermore that the cells of the nectaries are smaller and more quadrate than those of the tepal surface (Fig. 4C-F).

Stamens. In *F. chlororhabdota*, attachment of the anther to the filament is basifixed. Morover, filaments are rather stout and also shorter as compared with the closely related species *F. caucasica*. They are densely papillose in the upper part (Fig. 5A) and glabrous at the base (subglabrous or subpapillose) (Fig. 5B). Anthers are brown-purplish and ellipsoid in the indehisced state.

Pollen. Pollen grains in *F. chlororhabdota* are monsulcate (monoscolpate) (Fig. 6A). The general appearance of the pollen grains in this species is ellipsoid-fabiform (Figs. 6A, C). Exine seems to be rough due to small granulae and is foveolate-reticulate over all with bigger and smaller luminae (Fig. 6B, D). The layer of columellae is very visible at some angles (Fig. 6D). The colpi are rather large (Fig. 6C). The pollen shape and exine structure in *F. chlororhabdota* largely differ from those of the related *F. caucasica*. In this species, pollen grains are smooth due to absence of granulae, and more foveolate due to comparatively smaller luminae of varying size, of which the biggest holes are mainly concentrated laterally (sculpture terminology according to Faegri and Iversen 1989, Andersson and Persson 1991). Among Iranian species belonging to the *F. caucasica* group, the pollen shape and structure in *F. chlororhabdota* are closer to that of *F. pinardii*, but in this species the muri are generally narrower than those of *F. chlororhabdota*. Pollen grains differ in different taxa on the complex in general appearance and exine sculpture, *e.g.* presence or absence of knobs and size of luminae.

Style. The style is stout and densely papillose (Fig. 7A,B). The non-divided style in *F. chlororhabdota* separates it from *F. caucasica*, an allied species with trilobate styles, and also other species with 3-fid styles in the Caucasica group. The end of the style (stigmatic surface) is covered by elongate papillae (Fig. 7C).

PHYTOGEOGRAPHY

The genus *Fritillaria*, according to Beck (1947), is of Old World origin. It has its centre in the Orient, somewhere between Asia Minor and Northern Iraq and Iran, and has radiated out in different directions. Iran is the centre of diversity of this genus. The species in most subgenera are morphologically variable, some more than

Figure 1. *Fritillaria chlororhabdota.* Holotype (GBD 84).

Figure 2a. *Fritillaria chlororhabdota.* Lorestan, Dow Rud, Oshtoran Kuh, 1800m (type locality, GBD 84)

Photos: Gholamreza Bakhshi Khaniki

Figure 2b. *Fritillaria chlororhabdota.* West Azarbaijan, between Urmiah and Salmas at 1600m altitude (GBD 64).

Figure 2c. Flower of *Fritillaria chlororhabdota.*

others. Many taxa recognized within the Caucasica group present taxonomic problems. There occur many forms and intermediates probably due to introgression, particularly involving *F. pinardii, F. assyriaca* and *F. caucasica*. The parental origin of the forms observed is often uncertain. In Iran, few intermediates, particularly from the Caucasica group, have been reported. In Turkey, however, intermediates are frequent (Rix 1984), especially between *F. caucasica* and *F. assyriaca* and other members of the Caucasica complex. Generally hybridization must have played an important role in the evolution of the genus. Davis (1936) has found no *Fritillaria* hybrids in nature even between vicariant species, but Beck (1947) notes that "in their native habitats fritillaries do cross and this accounts for the extreme difficulty in determining many doubtful species". This possibility is also reconfirmed by Rix (1977) and Macfarlane (1978). According to the former author, there are many intermediate forms and possible hybrids (*F. grossheimiana, F. crassifolia* group) in Northern Iran where there is evidence of relatively recent destruction of forest vegetation. The pattern of variation of the species belonging to the Caucasica group also may be due to ecogeographical divergence of initially similar populations. *Fritillaria chlororhabdota* is widely distributed in Western Azarbaijan and the Zagros mountains (Fig. 8) and is geographically disjunct from the closely related species *F. caucasica*, which has been recorded from only one locality in Iran (Eastern Azarbaijan, the mountain of Kareh Dagh).

Rix (1984) mentioned the occurrence of *F. pinardii* in northwest and western Iran. Due to a certain similarity of this species to *F. chlororhabdota* in habitat, flower shape and phyllotaxy, it is quite possible that at least some of his specimens observed are in reality *F. chlororhabdota*.

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Table 1. Some particulars of the karyotype of *Fritillaria chlororhabdota*.

Pair	L+S (&m)	L	S	L/S	Type	Cl	L%	S%
1	6.51	3.46	3.06	1.14	m	47	6.64	5.89
2	5.83	3.54	2.28	1.55	m	39.20	6.79	4.39
3	5.06	4.49	0.57	7.89	t	11.26	8.62	1.09
4	5.87	4.43	0.44	10.00	t	9.08	8.50	0.85
5	4.53	3.99	0.53	8.51	t	11.70	7.66	1.01
6	4.05	3.44	0.60	5.71	st	14.9	6.60	1.16
7	3.85	3.45	0.39	8.81	t	10.20	6.62	0.76
8	3.81	3.27	0.59	5.41	st	15.56	6.28	1.14
9	3.59	2.95	0.63	4.67	st	17.56	5.66	1.20
10	3.52	2.95	0.61	4.74	st	17.34	6.66	1.17
11	3.33	2.81	0.51	5.45	st	15.30	6.40	0.98
12	3.07	2.71	0.35	7.60	t	11.38	5.20	0.67

Pair: figure indicating the pairs of homologous chromosomes, in decreasing order of the length.
L+S: total length of the chromosome.
L: length of the long arm of the chromosome.
S: length of the short arm of the chromosome.
L/S: arm index, ratio of long to short arm of the chromosome.
Type: type of chromosome based on arm index (Levan et al. 1965).
Cl: centromeric index. I.e., 100S/(L+S).
L% & S%: percentage of each arm of total length of the karyotype, *i.e.*, L%=100L/Σ(L+S) and S%=100S/Σ(L+S) (Oliva & Valles Xirau 1994).

Figure 3. *Fritillaria chlororhabdota*. A: mitotic metaphase (GBD 65; 2000x). Arrows: metacentric chromosomes; asteriscs: marker chromosomes no. 8. B: haploid idiogram.

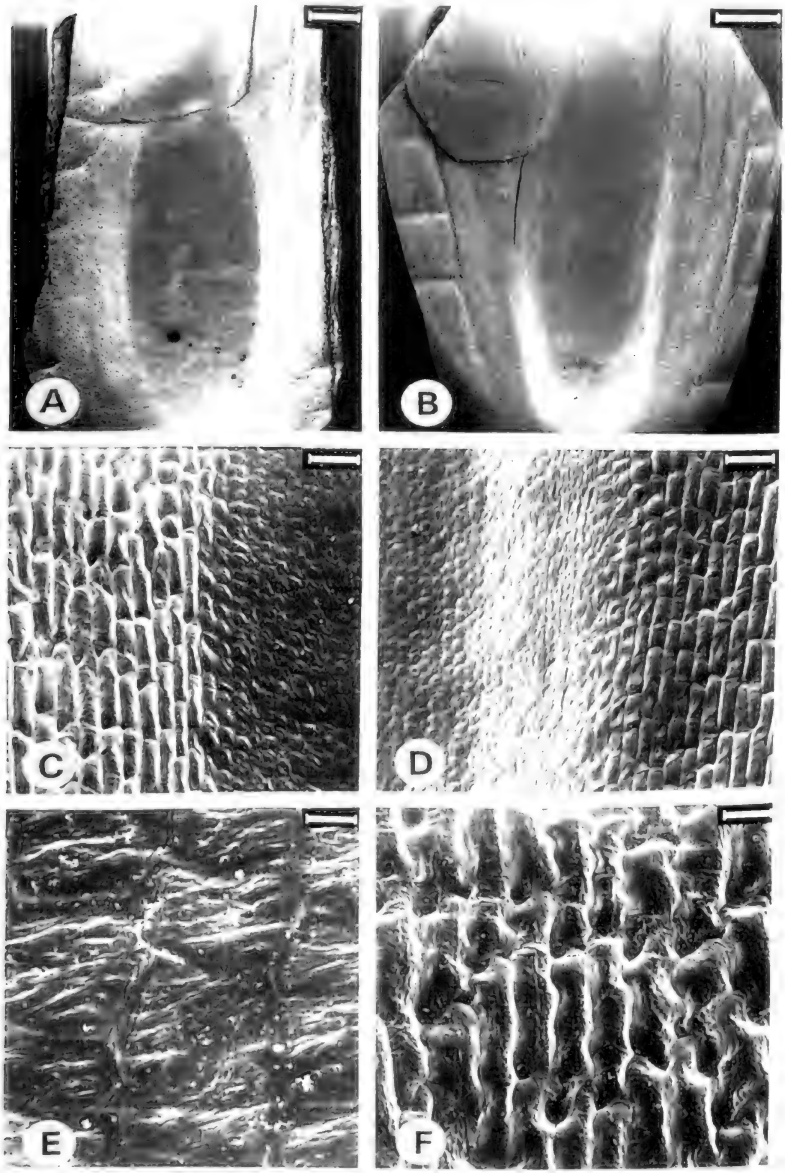

Figure 4. *Fritillaria chlororhabdota*, nectaries (GBD 65). A: nectary on outer tepal; B: nectary on inner tepal; C: cells from nectary border on outer tepal (nectary to the right); D: cells from nectary border on inner tepal (nectary to the left); E: nectary cells; F: ordinary tepal cells. Scales: A=B=1mm; C=D=100µm; E=50µm; F=10µm.

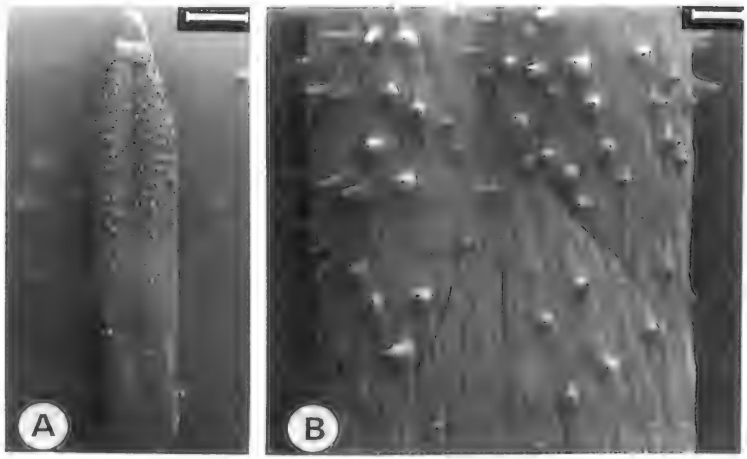

Figure 5. *Fritillria chlorohrabdota.* A: filament (anther removed); B: details of filament. Scales: A=1mm; B=200µm.

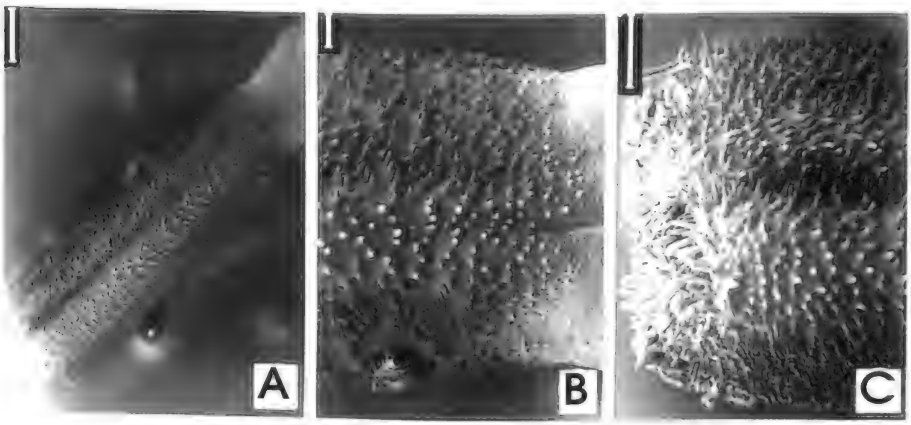

Figure 7. *Fritillaria chlororhabdota.* A: style; B: style base; C: style apex. Scales: A=1mm; B=200µm; C=500µm.

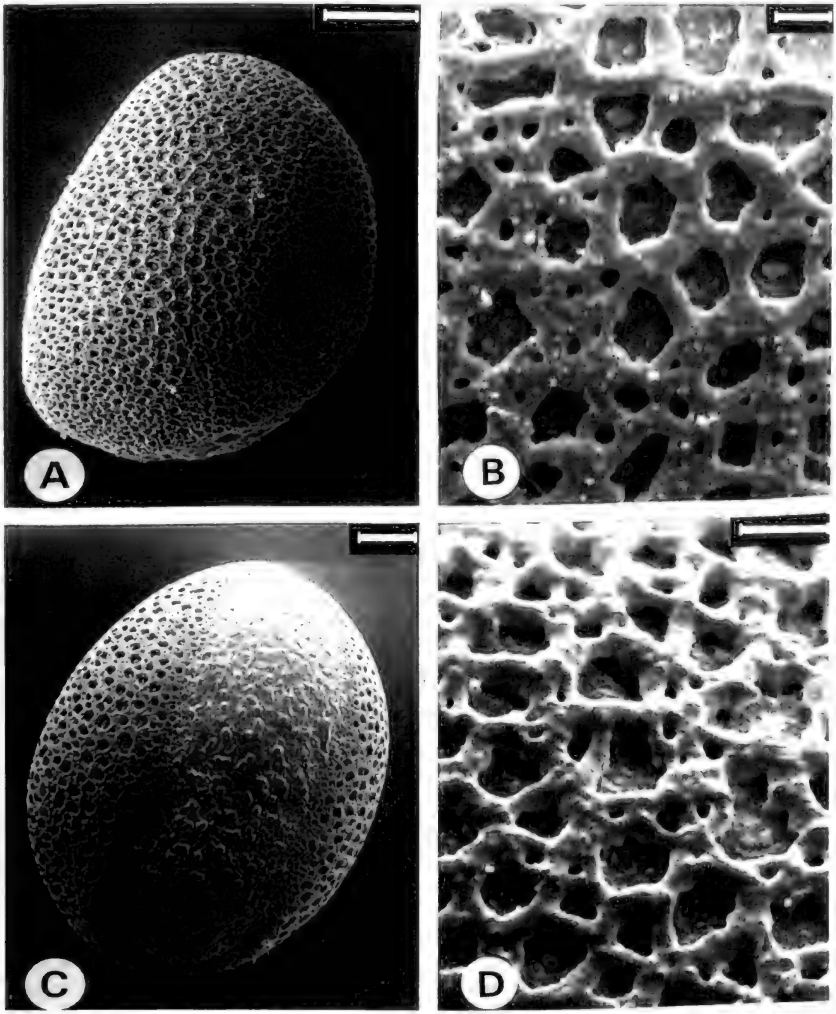

Figure 6. *Fritillaria chlororhabdota*. A: pollen grain; B, D: details of exine, note knobs (B) and columellae (D); C: pollen grain showing colpus. Scales: A,C=10µm; B,C=1µm.

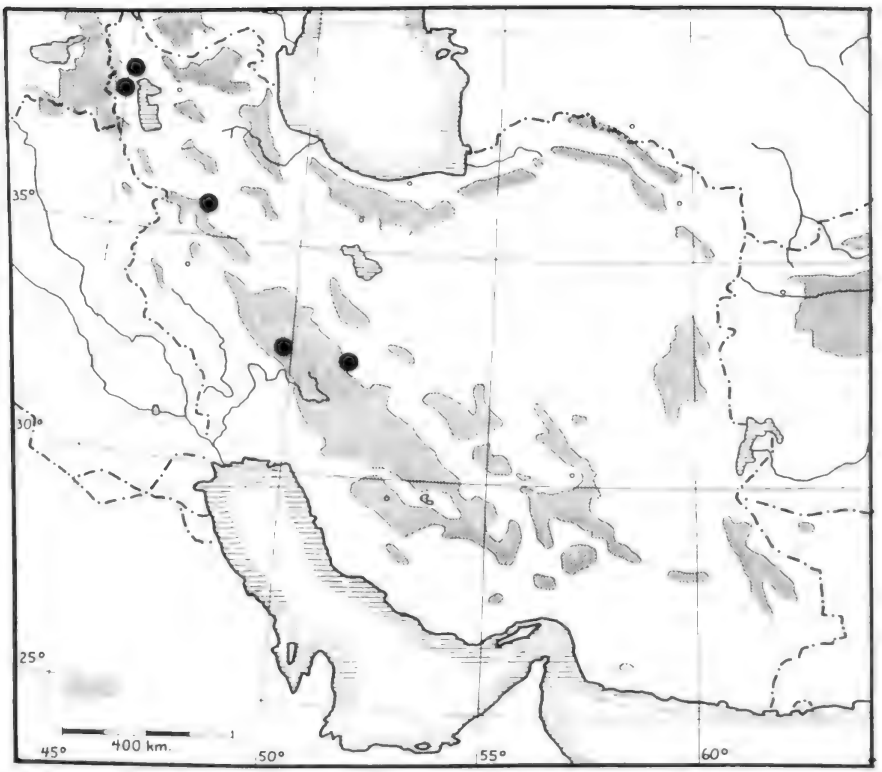

Figure 8. *Fritillaria chlororhabdota*. Geographical distribution.

HYBRIDIZATION IN *CYRTANTHUS*

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INTRODUCTION

Between November 1962 and February 1963 I spent three months in South Africa collecting bulbs together with Gordon McNeil (see **HERBERTIA** 43:20-21). Prof. R.A. Dyer in Pretoria had arranged a permit for me to collect six plants of each species of *Cyrtanthus* we could find. I was mainly interested in *Cyrtanthus* because of the many distinct chromosome types I had found in the species I had already studied cytologically (Ising 1962). Among them were *C. brachyscyphus* (earlier named *C. parviflorus), C. mackenii, C. mackenii* var. *cooperi* (earlier named *C. lutescens*), *C. sanguineus, C. falcatus* and *C. elatus* (earlier named *Vallota speciosa* or *C. purpureus*). All these had the diploid chromosome number $2n$=16.

According to Reid and Dyer (1984) the number of southern African species now known to science totals fifty. There are some species in tropical East Africa but they may be regarded as subspecies under *C. sanguineus* and *C. breviflorus* (I. Nordal 1979). During the three months trip around South Africa, Gordon and I collected over thirty species including the two species *C. elatus* and *C. breviflorus*, which earlier were regarded as belonging to separate genera, *i.e., Vallota speciosa* and *Anoiganthus breviflorus*.

The most recently described species are *C. montanus* discovered in 1972 and described by R.A. Dyer in **Flowering Plants of Africa** vol. 44 (1977) and *C. brachysiphon* found in 1981 and described by O.M. Hilliard and B.L. Burtt in **Notes from the Royal Botanic Garden**, Edinburgh (1986).

A revision of the genus *Cyrtanthus* in East Africa comprising the two species *C. beviflorus* and *C. sanguineous* has been made by L. Nordal (1979). She points out the polymorphism of *C. sanguineus* and divides it into four subspecies.

EARLY CROSSES

Earlier I had made crossings between *C. brachyscyphus* and *C. mackenii* (white, yellow and pink varieties). These hybrids were almost fully fertile in seed set and had a pollen fertility of 80%. However, they seemed to differ by a paracentric inversion in the largest of the chromosomes. By colchicine treatment of bulbs and seedlings I had also produced tetraploids ($4x$=32) of these two species and of their hybrid (Figs. 1, 4; Ising 1966). Such tetraploids were backcrossed as mother plants to the diploids and gave an almost full seed set (24 seeds per capsule in mean). The triploid

progeny plants had chromosome numbers ranging between 22 and 26. About half of them had the exact triploid number of chromosomes ($3x$=24). When selfed the tetraploids gave around 12 seeds per capsule compared with around 22 seeds per capsule in the diploid hybrids.

CHROMOSOME BALANCE AND CHROMOSOME BREAKS

The further crosses between triploids and diploids gave rise to aneuploids with chromosome numbers between 16 and 24, representing over 150 different chromosome combinations. The unusually good viability of the aneuploid individuals was similar to or even better than that described by Darlington and Mather (1944) for *Hyacinthus*. These studies later resulted in the paper "Aneuploidy and internal chromosome balance" (Ising 1969a). The viability of different chromosome combinations was estimated and clear differences were found, indicating that certain chromosomes were more and certain were less dependent on each other. Chromosomes which are almost independent of each other (chromosomes A, G and H) will vary in frequency between plants more often that the dependent chromosomes do (B,C,D,E and F).

Another phenomenon observed in this material was the frequent occurrence of spontaneous structural chromosome changes (translocations and inversions) especially in the single, double and triple trisomics. Twelve percent of these individuals (45 of 375 plants) showed new structural chromosome changes (Ising 1969b). The reason for this phenomenon was an almost unsolved mystery. Now, it seems likely that the genetically unbalanced condition has induced the mobility of some kind of transposable elements. These in their turn can cause chromosome breakage and structural chromosome changes during mitotic divisions.

CHROMOSOMAL VARIATION AMONG SPECIES

The species collected were also studied and compared as to their chromosome morphology (Ising 1970). Together with seven species which had been studied by other authors (Flory 1955; Gouws 1949 and Wilsenach 1963), there were 28 species studied as to their chromosome morphology. All of them had the diploid chromosome number $2n$=16, but among twenty-two collections of *C. breviflorus* from the Cape Province, Natal and Swaziland there were three (one from the Cape Province and two from Natal) which had the tetraploid number $2n$=32 (Figs. 7, 10). These collections were studied more in detail both cytologically (Ising 1969c) and with thin-layer chromatographic methods for the separation of phenolic compounds in the leaves (Ising and Frost 1969). Because of a tendency for allotetraploidy in these tetraploids, it is very likely that they represent polyploidization of different hybrids among

ecotypes having a slightly different chromosome morphology.

Among the 19 diploid collections studied, there were two (M and O) having a very deviant chromosome morphology, which I at that time thought belonged to *C. breviflorus* (Ising 1969c, Ising and Frost 1969). They originated from Pigg's Peak and Mbabane in Swaziland. As was shown later, they belong to another species, namely *C. nutans*, which had not been found that far north earlier (Reid and Dyer 1984). Like *C. breviflorus*, this species has yellow flowers with segments almost as long as the tube. The bulb and the leaves are more like those of *C. sanguineus*. Also the karyotype is very similar to that of *C. sanguineus*. It is therefore evident that some of the conclusions drawn in the two papers about *C. breviflorus* have to be revised. However, I succeeded in making a cross between this species, *C. nutans* and *C. brachyscyphus*. A drawing of the chromosomes of this hybrid is given in figure 11 of my "Cytogenetic studies in *Cyrtanthus*. IV". (Ising 1969c). The plant died before flowering.

Before our travels, when Gordon and I started to look for localities in the herbarium in Pretoria, we found a collection from the forties under the name of C. *sanguineous* that morphologically deviated from a true type of *C. sanguineus*. It was collected in the Transvaal not far from Barberton and we were later happy to find thousands of them in flower when we visited the place on the 4th of January 1963 (Figs. 3, 8). It looked like a small orange *C. elatus* but it had flowers much smaller than *C. sanguineus* which, from chromosome studies, seems to be the nearest relative. The two species differ in at least four of the eight chromosome types (Ising 1970; Fig. 17). The flowers do not recurve as in *C. sanguineus* and in addition the anthers are differently placed. It was named *C. eucallus* by R.A. Dyer (1964). It was later crossed with *C. brachyscyphus, C. mackenii* and *C. sanguineus*.

POLLEN FERTILITY OF HYBRIDS

The hybrids between *C. eucallus* and *C. sanguineus* are very fertile and for the 24 individuals studied, the pollen fertility varied between 51% and 89% with a mean of 66%. This indicates that the two species differ by at least one large translocation. *Cyrtanthus eucallus* grows under very wet conditions while *C. sanguineus* seems to prefer dry places. From a cross between *C. eucallus* and *C. fergusoniae* I got two flowering plants with 10% and 14% pollen fertility, respectively. A hybrid between *C. elatus* and *C. eucallus* was treated with colchicine and produced a tetraploid sector but unfortunately the plant later died while young. Such a hybrid would certainly be most interesting from a horticultural point of view.

Hybrids between *C. sanguineus* and *C. elatus* are especially interesting. Normally the hybrids are diploid with a pollen fertility

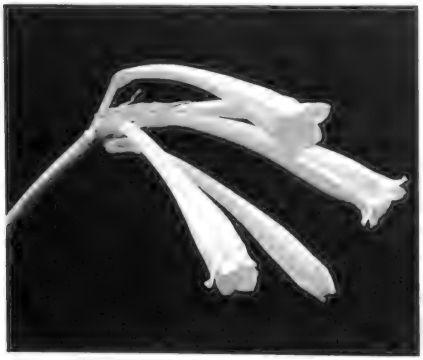

Fig. 1. *Cyrtanthus mackenii*. Yellow tetraploid.

Fig. 4. *Cyrtanthus mackenii* x *C. brachyscyphus*. Diploid F_1 and tetraploid F_1.

Fig. 2. *Cyrtanthus mackenii* x *C. brachyscyphus* (plant no. Z69:3).

Fig. 5. *Cyrtanthus mackenii* x *C. sanguineus* (plant no. D46:8).

Fig. 3. *Cyrtanthus eucallus*.

Fig. 6. (*Cyrtanthus mackenii* x *C. brachyscyphus*) x *C. eucallus*.

Fig. 7. *Cyrtanthus breviflorus*, diploid.

Fig. 10. *Cyrtanthus breviflorus*, tetraploid.

Fig. 8. *Cyrtanthus sanguineus.*

Fig. 11. *Cyrtanthus clavatus.*

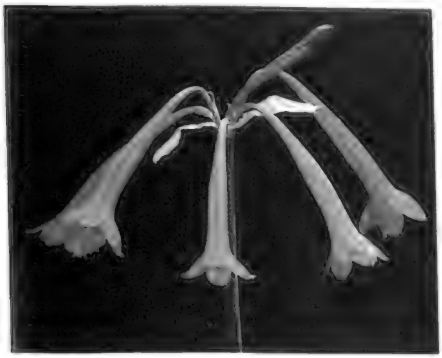

Fig. 9. *Cyrtanthus contractus.*

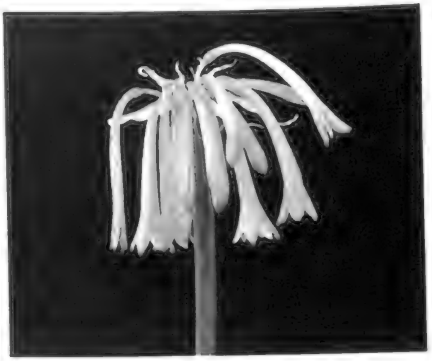

Fig. 12. *Cyrtanthus carneus.*

of about 15% and such plants usually will not give any seeds when selfed. To my surprise, however, when *C. elatus* was used as pistil parent, I often got triploid seedlings. These had two sets of chromosomes from *C. elatus* and one set from the pollen parent *C. sanguineus* (Ising 1991). These triploids have a pollen fertility of about 75%, thus markedly different from their diploid sister plants. The two hybrid types also can be distinguished from each other by use of a morphological character that is different in the two parental species, namely the length of the stigma branches. While *C. sanguineus* has a trifid pistil with stigma branches of 8-9mm, the pistil of *C. elatus* is pointed without branches. The triploid hybrids have shorter branches (2-3mm) compared to the diploid hybrids (4-5mm). The triploid hybrids are also larger than the diploids, especially in flower characters. Not only Gordon McNeil and I produced these two types of hybrids, but they were also noticed by a gardener in Holland, Mr Stein in Poeldijk, who had gotten pollen of *C. sanguineus* from me by letter in 1963. As his *C. elatus* was of a different origin than mine, it was evident that the capacity of producing triploid embryos in this cross was not restricted to my clone of *C. elatus*. The hybrid between *C. elatus* and *C. sanguineus* was also reported by H. Koopowitz in **HERBERTIA** (1986). I have also seen one pressed specimen of what I think is this hybrid in the herbarium at Kew Gardens in London (preserved in 1888 by I. Lawrence).

Frank Holford in Cornwall, U.K., also has crossed *C. elatus* with *C. speciosus* (wrongly named *C. capensis* by Traub in 1972, see Hilliard and Burtt, 1986). This species has white flowers and is closely related to *C. sanguineus*. Among his hybrids Holford has plants both with longer and shorter stigma branches. As the former have cream flowers and the latter have pink flowers, it is possible that the former may represent diploids and the latter triploids. The latter also have higher pollen fertility like my triploid hybrids.

Cyrtanthus elatus also may be crossed with other big species of *Cyrtanthus* like *C. obliquus*, and such hybrids may be fertile with each other if different individuals of *C. obliquus* have been used in the crosses (Figs. 14, 15). The reason for this is that there is some kind of self sterility in *C. obliquus*. Thus, the F_1 hybrids I had were self-sterile in spite of having almost 50% good pollen. Among other species, which will be worth trying in crosses to *C. elatus*, are *C. carneus* (fig. 12), *C. eucallus, C. falcatus* and *C. fergusoniae*. I once had a hybrid between *C. elatus* and *C. fergusoniae* but unfortunately it died before flowering. Frank Holford has made hybrids between *C. falcatus* and *C. elatus* (fig. 18). They have a pollen fertility of about 30%. The hybrids between *C. elatus* and *C. fergusoniae* as well as that between *C. elatus* and *C. falcatus* also have been made by H. van Zijl in South Africa.

Cyrtanthus montanus (fig. 16) described by R. Dyer in **Flowering Plants of South Africa**, vol. 44, 1977, is closely related to *C. elatus* and also will produce a lot of small side bulbs like *C. elatus* and *C. fergusoniae*. This species is easier to cultivate than *C. elatus* and often has up to ten flowers per umbel. F. Holford has used it in crosses with *C. elatus, C. guthriae* and other species. *Cyrtanthus guthriae* is closely related to *C. elatus* and has large flowers with a gold glitter. It gives fertile hybrids both with *C. elatus* and *C. montanus*. The hybrid between *C. montanus* and *C. guthriae* (fig. 17) has a pollen fertility of 85%.

THE SMALL SPECIES

The small species, *C. mackenii, C. brachyscyphus, C. breviflorus* and *C. tuckii* form a natural group as far as chromosome morphology is considered. Taking into consideration their chromosome morphology, *C. huttoni* and *C. erubescens* also belong in this group. Because of their size and vigour and probably better cold resistance, it would be of interest to try crossing these two species to the smaller species *C. mackenii* and *C. breviflorus*. If the hybrids are fertile they would certainly give very variable and interesting F_2 material.

The species with small flowers like *C. mackenii* and *C. brachyscyphus* do not easily cross with *C. elatus*. They may cross, however, with *C. eucallus,* and with some difficulties, with *C. sanguineus* and *C. clavatus* (Fig. 5). *Cyrtanthus sanguineus* has been crossed with different hybrid plants from the cross between *C. mackenii* and *C. brachyscyphus* (Fig. 2). All the progeny were diploid and completely self sterile. The pollen fertility was about 5% but varied between 1% and 13% for the different individuals. Gordon McNeil succeeded in getting some progeny of very variable morphology. Five such individuals have been studied cytologically and they were all diploids with $2n=16$. They combine the parental chromosomes in a very interesting way, thereby to some extent revealing the true homologies between the different chromosomes of the two parental species. Hybrids from the cross between *C. sanguineus* and *C. mackenii* may be used, however, as pollen parents in crosses with *C. elatus,* sometimes resulting in new types of hybrids.

Plants from the *C. mackenii* x *C. brachyscyphus* material also have been crossed with *C. eucallus* and three studied plants had a pollen fertility of 2.2%, 3.9% and 5.5%, respectively (Fig. 6).

A 2x:4x mixoploid individual of *C. mackenii* was produced by treating young embryos at early cell divisions (between 60-70 hours after pollination) with nitrous oxide (NO_2) at a pressure of 10 atm. When this plant was crossed with *C. sanguineus* it produced a triploid individual among some diploids. This triploid had a pollen fertility of 88% compared to 2% for a diploid sister plant. My con-

Fig. 13. *Cyrtanthus sanguineus* x *C. elatus.*

Fig. 16. *Cyrtanthus montanus.*

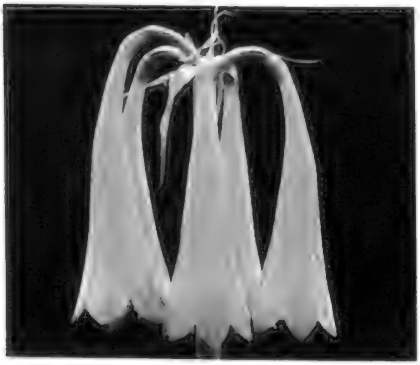

Fig. 14. *Cyrtanthus obliquus.*

Fig. 17. *Cyrtanthus guthriae.*

Fig. 15. *Cyrtanthus obliquus* x *C. elatus.*

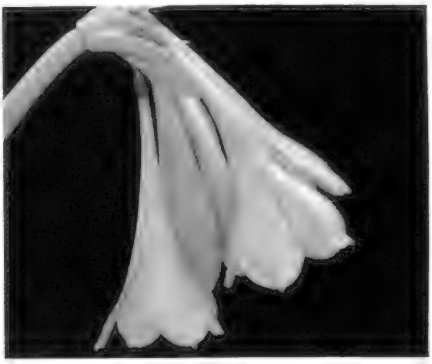

Fig. 18. *Cyrtanthus falcatus* x *C. elatus.*

clusion is that the two homologous chromosome sets of the triploid may pair preferentially and the third set is distributed more or less at random.

Gordon McNeil (1962) reported that he had made the following crosses: "*C. sanguineus* x *C. tuckii* var. *viridilobus*, *C. sanguineus* x *Vallota speciosa* (=*C. elatus*), *C. sanguineus* x *Anoiganthus luteus* (most likely *C. nutans*), *C. sanguineus* x *Anoiganthus breviflorus* (=*C. breviflorus*) and *C. sanguineus* x *C. galpinii*. I never got any opportunity to see these hybrids in flower.

AN INTERMEDIATE GROUP

Cyrtanthus fergusoniae and *C. contractus* (Fig. 9) are certainly closely related to each other and their chromosomes do not differ much in morphology from those of *C. sanguineus*. From my cytological studies (Ising 1970), I also draw the conclusion that *C. contractus*, *C. sanguineus* and *C. eucallus* will constitute one group of related species. Whether *C. spiralis* and *C. ventricosus* also belong in this group is uncertain, but they have many morphological similarities to *C. contractus*.

Now, I know that *C. nutans* also belongs to this group. Not too far from this group stands *C. clavatus* (Fig. 11) and *C. loddigesianus* (earlier *C. affinis*). As H. Koopowitz (1986) reports, crosses between *C. sanguineus* and *C. smithiae* and between *C. sanguineus* and *C. speciosus* (named *C. capensis*) are possible. It is likely that all these species can be combined into a group of nearly related species. I also made hybrids between *C. galpinii* and *C. sanguineus* as well as between *C. galpinii* and *C. mackenii*, but unfortunately they died before flowering. It is likely that *C. thorncroftii* also belongs to or stands near this group.

THE BIG SPECIES

Cyrtanthus elatus and *C. montanus*, which yield fertile hybrids when crossed with *C. elatus*, may stand between the species in the intermediate group and another group composed of the three big species: *C. obliquus* (Fig. 14), *C. falcatus* and *C. herrei*. It is likely that the big *C. carneus* (Fig. 12) also belongs in this group even if good chromosome preparations have not been available for comparison. Hybrids between *C. elatus* and *C. obliquus* (Fig. 15) as well as between *C. elatus* and *C. falcatus* (Fig. 18) are easily produced. Most likely *C. montanus* will cross with the other species as well and produce even more vigorous hybrids.

A FOURTH GROUP OF SPECIES

Finally, there is a fourth group of species which, judged from chromosome morphology, may be placed between the group of

small species containing *C. mackenii* and the group containing *C. sanguineus*. This group contains *C. stenananthus*, *C. rotundilobus*, *C. epiphyticus* and *C. obrienii*. According to Reid and Dyer (1984), it is also likely that *C. epiphyticus* and *C. obrienii* possibly together with *C. junodii*, *C. rectiflorus* and *C. rhododactylus* represent forms of *C. macowanii*. The morphological and cytological variation within this group would be worth a more careful study.

From my experience, species in this group will cross easily with *C. brachyscyphus* and *C. mackenii* and other species in the first mentioned group of small species. However, there are pronounced cytological differences between these two groups, especially in chromosomes D and H, which justifies their separation into two separate groups (Ising 1970). Two hybrid plants of the cross *C. stenanthus* x *C. brachyscyphus* have flowered and they had a pollen fertility of 65% and 78%, respectively.

CONCLUSION AND FUTURE PROSPECTS

The genus *Cyrtanthus* has many species, which can be grouped in at least four distinct groups with marked cytological differences. Crosses are possible not only within groups but also between species in different groups, with the exception perhaps, of crosses between the large species in the *C. obliquus* group and the small species in the *C. mackenii* and *C. stenanthus* groups. Hybrids between species in these latter two groups are fertile compared to hybrids between species in these two groups and species in the *C. sanguineus* group, which usually are sterile with low pollen fertility (below 10%).

Cyrtanthus elatus and *C. montanus* may be crossed both with species in the *C. sanguineus* group and with species in the *C. obliquus* group thereby forming a connecting link between these two groups. Most likely these two species stand nearer to species in the *C. obliquus* group as the *C. obliquus* x *C. elatus* hybrid has about 50% good pollen and the *C. elatus* x *C. falcatus* hybrid has about 30% good pollen compared with about 15% for the diploid *C. elatus* x *C. sanguineus* hybrid.

Figure 19 is a listing of some *Cyrtanthus* species together with representative pictures of plants in the different groups. All hybrid combinations mentioned in the text are indicated by lines connecting the two species involved.

Cyrtanthus elatus x *C. sanguineus* sometimes produces triploid hybrids with a pollen fertility of about 75% and these may be useful as pistil parents in some crosses giving few seeds but a more variable progeny.

Tetraploids have been produced in only a few cases, namely the hybrid *C. mackenii* x *C. brachyscyphus* and the hybrid *C. mackenii* x *C. sanguineus*. These hybrids have a pollen fertility between 80

and 90% but the seed set is reduced to one third or, in the best case, half of that of the diploid parents. The size and vigour of such tetraploid hybrids may, however, be much improved compared to the parental species. Also, one tetraploid plant was produced in the cross *C. elatus* x *C. eucallus;* unfortunately this interesting hybrid died before flowering. There is still much to attain in constructing new and commercially valuable tetraploid combinations.

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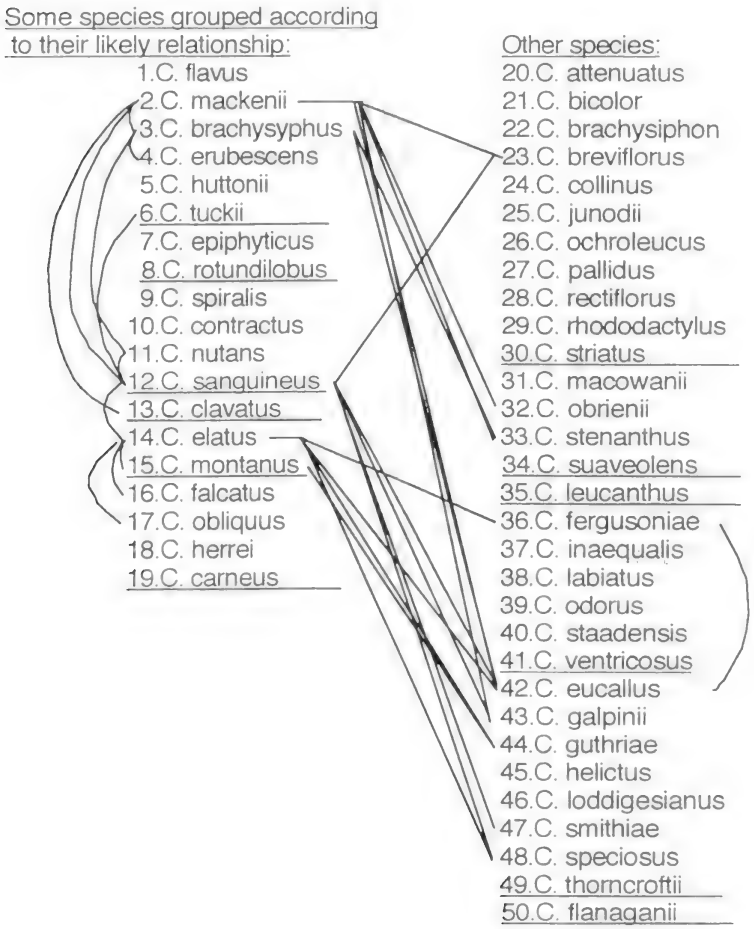
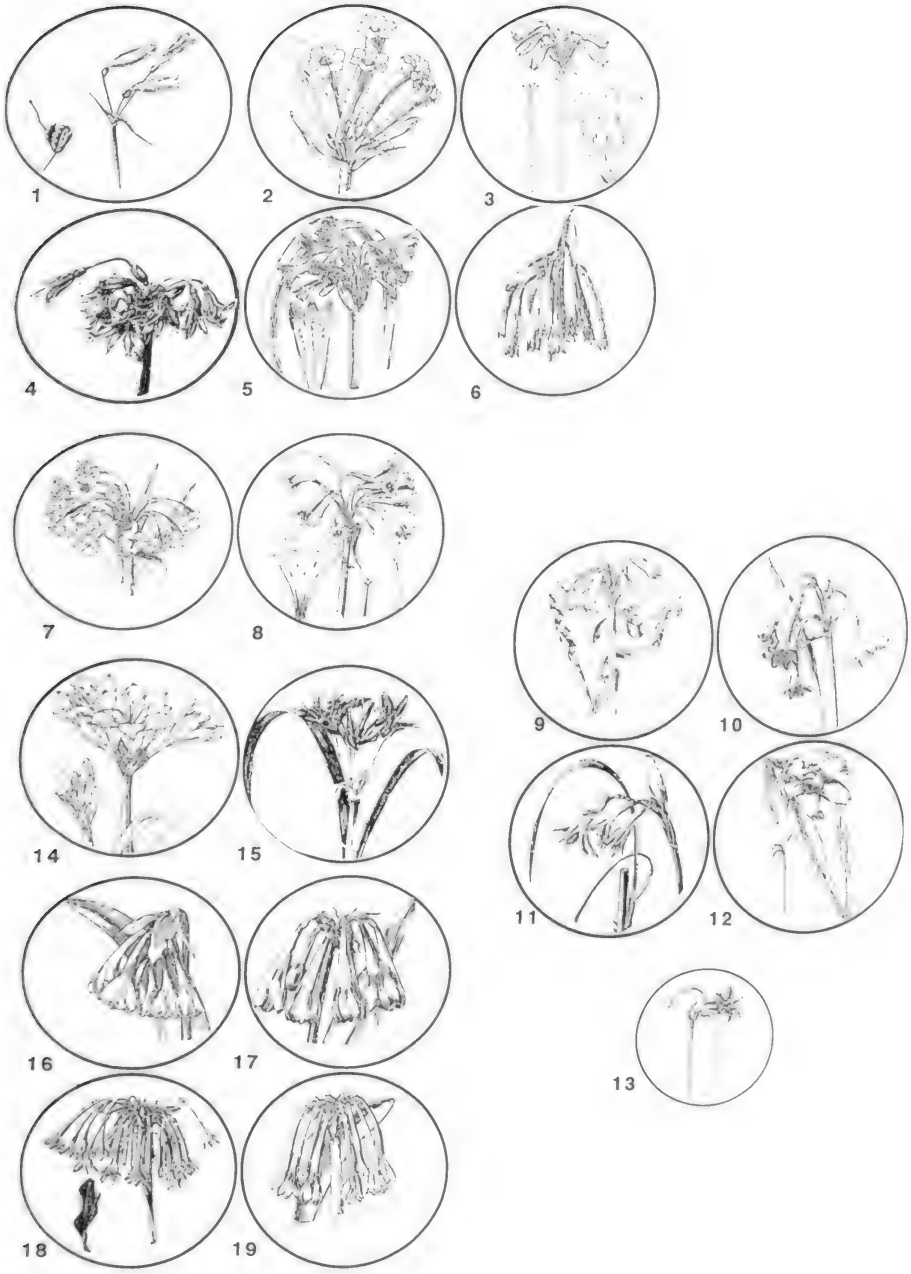


Fig. 19. *Cyrtanthus* species grouped according to their likely relationships.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LIVING JEWELS: NUMBER 5 IN A SERIES

TULIPA WILSONIANA

Charles Hardman
Baldwin Park, California

Tulipa wilsoniana is a delightful species tulip which surprises me yearly by not only growing but actually blooming, as well.

While this feat may not seem like much of an accomplishment to those lucky (? you decide) growers in colder climes whose soils and winter temperatures encourage their tulips to reappear annually in ever more abundantly flowering profusion, to tulip-starved residents of Southern California *T. wilsoniana* is a real discovery.

While it's true we have *T. clusiana* (white segments with rose-pink reverse) and its varieties: 'Cynthia', larger than *T. clusiana* itself and having yellow petals with a rose reverse, and another form received under the name 'Cynthia', but which sports a peachy petal color instead of yellow but a similar rose reverse, what other tulips do we have that grow, multiply and bloom year after year here in the hot inland valleys of sunny Southern California? Well, there are two others that I know of which do well: *T. saxatilis,* lilac rose with a big yellow center; often with multiple flowers (up to five for me) per stem and *T. bakeri* 'Lilac Wonder', looking almost exactly like *T. saxatilis* except that it's a bit shorter and, under my conditions, at least, only occasionally shows more than one flower per stem.

And now there is fourth *Tulipa* species for Southern California: *Tulipa wilsoniana.* I have never seen this species listed in lists of tulips that grow and bloom in warm climates so I am grateful to have found it for not only does it increase our warm-climate-adaptable tulip species range it also extends our tulip color palette—*T. wilsoniana* is a brilliant lacquered red of just about the same shade as the automobile color we've come to know as Candy Apple Red. John Bryan calls it a deep, vermillion red.

Not that one can't grow this species in colder climes. John Bryan informs us that this species is "Native of the mountains of Turkmenistan in Iran" and that it reaches 3-4 inches in height. Just what this native locale information means insofar as cold tolerance is concerned is a little hard to tell from this brief description. But it sounds like the species is at least worth a try even if you do live where the weather gets cool. Or even cold. I suspect one key to its blooming for us here in Southern California may be that our summer weather gets so hot and dry. Perhaps these conditions are what it gets in its native haunts and therefore requires in order to do well year after year.

My plants reach 5-8 inches (13-20cm) in height if I don't cool

the bulbs (in my refrigerator's crisper, from four to six weeks) and 8-10 inches (20-25cm) in height if I do. Nevertheless, even at these taller heights I think of *T. wilsoniana* as a wee munchkin, for in flower form and overall dimensions it's such a near perfect replica of the big red hybrid tulips that it always makes my sense of delight take over, bringing a smile to my face. Flower size is 1½ to 2 inches (2.5-5cm).

Now if what I have said already doesn't excite your bulb lover's imagination, here are a few more facts about this lovely species tulip which may: it requires no special care; its foliage is a lovely glaucous color; it makes a perfectly charming cut flower; its brilliant red color is one that my local aphids aren't especially attracted to (aphids are especially attracted to the color yellow although, in my garden, pink and white colors also command their attention); it holds its flowers well even in hot weather.

In addition, it is always fun to try growing something a little different and *T. wilsoniana* is just that. Recently, Dutch Gardens (in the Source List) has carried this species in its autumn catalog.

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Tulipa wilsoniana

Photo: Charles Hardman

TRENDS IN MODERN *HIPPEASTRUM* HYBRIDIZING

Charles Hardman
Baldwin Park, Southern California

Hippeastrums, which most Americans still call amaryllis, have enjoyed waves of enormous popularity throughout their culture. It's no wonder: They are powerfully beautiful when in flower and architecturally beautiful when in leaf.

Hippeastrums have enjoyed several peaks of enthusiasm during the eighteenth, nineteenth and twentieth centuries. *Hippeastrum reginae* was introduced into cultivation in 1728. Its most popular hybrid, *H.* x *johnsonii* (*H. reginae* x *H. vittatum*), is considered by J. G. Baker to be the first hybrid among *Hippeastrum* species. This cross, made originally in 1799 by a watchmaker of Prescot in Lancashire whose name was Johnson, is still widely grown throughout the world. Forms of *H.* x *johnsonii,* its children and grandchildren down to the n^{th} generation are so widely observed in springtime blooming in yards throughout Southern California that one would almost think it a native of the area. Fortunately, *H. reginae* itself, while not tough as nails, is one of the heartier species and it passes on its strength and resistance to cool temperatures to its progeny along with much of its awe-inspiring beauty.

By 1830 about 100 *Hippeastrum* crosses had been made and given Latin names. Since then and in spite of occasional lulls, hybridizing within this incredible genus has never stopped.

The early part of the current century brought wide experimentation in hybridizing as modern breeders built on the work done in the eighteenth and nineteenth centuries by earlier hybridizers. From the 1930's through the 1960's, massive, rounded flowers and self colors were in vogue among hippeastrum connoisseurs. Often, these were exhibited at local flower shows. Few plant enthusiasts can resist the beauty of hippeastrums, so it's not surprising that work went on in various parts of the world—The Netherlands, South Africa, Australia, New Zealand, Japan, and the United States. But it was in The Netherlands and South Africa that many of the most famous cultivars were developed. Throughout the world the names "Dutch Hybrid amaryllis" and "South African Hybrid amaryllis" are synonymous with quality, beauty, vigor and ease of bloom.

The 1970's saw a trend towards more flower scapes per bulb, tough cultivars that would flower even if you left them in a paper bag without the benefits of planting and a spinoff movement toward smaller, daintier flowers. This latter movement never quite took hold, the public's demand for the huge washing over it like a tsunami. Nevertheless, some worthy smaller cultivars still surface

occasionally and "Scarlet Baby"—also called Gracilis Dulcinea—is still very much in evidence in the dry bulb trade.

The 1980's brought us a lessening of interest in growing hybrids and an increasing interest in species cultivation. Interest in the cultivation of *Hippeastrum* species continues to this day, as the International Bulb Society's autumn, 1996 sale of *Hippeastrum* species from the Doran Amaryllid collection showed. But sources of species supply are seriously depleted throughout much of South America. Even thirty years ago collectors such as Leonard Doran saw these sources drying up. A *Hippeastrum* plant which flowers in the wild and is seen by a local inhabitant is almost certainly doomed, for it is the custom among the locals throughout much of South America to dig up the entire plant, bulbs and all, and take it to a market where the digger may possibly have a chance to sell it for the few pennies it will bring.

The period from the late 1980's into the early 1990's saw interest in hippeastrums wane somewhat but the latter part of our current decade is producing a revival of sorts along with several trends worth mentioning.

Three of the general trends I've noticed lately is a burgeoning of interest in *Hippeastrum* hybridizing by professionals and amateurs alike along with an increasing desire to grow the species and a parallel effort on the part of some enthusiasts to rescue older cultivars from oblivion and to grow and propagate them for future generations. All of these endeavors are important not only to the present but to the future of this lusciously flamboyant genus.

Hippeastrum hybridizers are having a field day. Here are some of the current directions they're taking their work.

YELLOW, YELLOW-GREEN AND GREEN "AMARYLLIS"

Yellow hippeastrums have been with us for quite a while, although they're just now beginning to be seen more often in catalogs and in private collections.

Four *Hippeastrum* species are yellow. They are:

- *H. aglaiae*—a pale yellow, really more of a cream color;
- *H. anzoldoi*—lemon yellow, at times it almost seems to have a hint of blue (some taxonomists consider this a form of *H. evansiae* but others feel there are sufficient differences to qualify it as an unique species);
- *H. evansiae*—chartreuse yellow to creamy yellow, quite variable, nearly always has some pink and, in fact, some forms have a lot of pink;
- *H. parodii*—yellow leaning towards chartreuse.

Yellow hippeastrum hybrids also have been with us for quite a while. Two of the best I've ever seen were spotted growing in their pots in a plunge pit full of sawdust at the University of Southwest Louisiana at Lafayette, Louisiana. They were hybrids which had emerged from the late Dr. Ira S. Nelson's hippeastrum hybridizing program. Dr. Harold Koopowitz, Dr. Ken Mann, Fred Meyer and I rented a car and took a side trip up to the University during the American Plant Life Society's 1986 Symposium in Baton Rouge, Louisiana. (As the result of a later name change the APLS became this Society, the International Bulb Society.) We went for the specific purpose of seeing Dr. Nelson's *Hippeastrum* collection which was blooming at the time.

Once we arrived at the *Hippeastrum* plunge pit containing Dr. Nelson's hybrids, there were many good flowers blooming from the cultivars growing in their pots. The two yellow cultivars were spectacular, large flowers combined with fairly good yellow coloring, a deeper hue in one than in the other. I doubt either of these yellows was introduced.

The late Charles "Dee" Cothran also worked with yellow hippeastrums. In an article titled "Quest for Large, Yellow Hippeastrums" Dee mentions a hybrid called 'Chatterbox' (presumably his own) and a later hybrid (definitely his own) which he called 'Yellow Pioneer'. What happened to 'Chatterbox' I don't know.

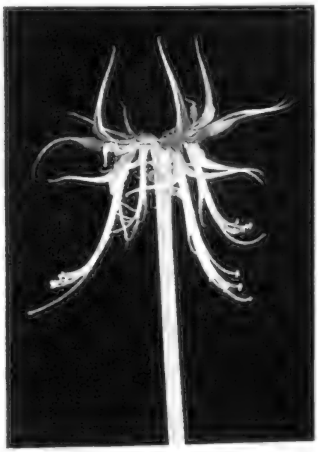
As for 'Yellow Pioneer', that's another matter altogether. One day I spotted a yellow hippeastrum in a flower catalog. It was called 'Yellow Pioneer' and it looked like the hippeastrum of the same name which Dee had entered at a local amaryllis show. I called Dee and discovered during our conversation that he had never been approached about propagation rights and was surprised to learn that 'Yellow Pioneer' was in commercial production.

Dee Cothran never received so much as a penny in royalties for his hybridizing work on 'Yellow Pioneer'. Moral: If you hope to make money from your hybridizing work, curb your generosity.

I have grown 'Yellow Pioneer'. It likes more heat than I give it in my (largely) unheated greenhouse and, under my conditions, tends to break up by diverting its energies away from flower production and into smaller and smaller bulbs and bulblets.

There's also a new yellow variety available commercially called 'Lemon-Lime'. This one is milky-chartreusey cream in color, perhaps a bit less yellow for me than 'Yellow Pioneer'. My medium-sized bulb produced three tall flower scapes with six, four and four flowers. ('Lemon-Lime' has the odd characteristic of producing a dimple, sort of a little pucker or pit, in many of its segments. Where that comes from, I don't know.)

Hippeastrum 'Lemon-Lime'



Hippeastrum cybister

Hippeastrum traubii
forma *doraniana*

Hippeastrum 'Picotee'

Photos: Charles Hardman

Red *Hippeastrum* hybrid
developed for garden flowers.

Hippeastrum x *johnsonii*

Amaryllis, Inc., [see Source List, page 193] carries two new yellow cultivars, 'Yellow Queen' and 'Yellow Trumpet'. I have not grown either of these cultivars but they do sound interesting. No doubt there are other yellow hippeastrums available and probably more in the works being readied for future introduction.

'Yellow Pioneer' and 'Lemon-Lime' mark progress in yellow hippeastrum hybridizing. More progress needs to be made so this is either a wide-open field for people interested in working toward outstanding yellows or a field in which limitations of the intensity of the yellow coloring itself will delay or even stop progress. Fred Meyer feels that, eventually, we may get good yellows of about the intensity of a yellow petunia but that the genes available won't lend themselves beyond that into the brilliant yellows or golds.

While there no doubt will be difficulties to overcome in hybridizers' forward march toward the perfect, large-flowered yellow, there's some good news, too. Years ago Edward O'Rourke determined that the yellow color in *Hippeastrum* species is a carotinoid. What this means for hybridizers is that the yellow factor can be hybridized with and passed along from parents to progeny.

By the way, while *H. anzoldoi* and *H. evansiae* enjoy, even demand, warm temperatures, *H. aglaiae* can be grown outdoors in Southern California where the temperatures often descend into the twenties (°F) and even the teens during the winter.

As for *H. parodii* my notes on it read "Hot summers/cold winters".

There are at least three green *Hippeastrum* species. These are:

- *H. aviflorum*—green;
- *H. calyptratum*—green or creamy green (an epiphyte);
- *H. parodii*—which I previously mentioned among the yellow species but which can be on the borderline between yellow and green, sometimes more green or chartreuse than yellow or mint-white; can also be an odd gray-chartreuse color.

To my knowledge, little hybridizing work has been done with these species. *Hippeastrum aviflorum* is not easy to acquire and *H. calyptratum* is not easy to grow (perhaps its epiphytic nature has something to do with that). *Hippeastrum parodii* is easier in both respects and does offer some hope to hybridizers who might be interested in its trumpet form.

In addition, there are other *Hippeastrum* species which offer green or yellow-green coloring in parts of their flowers. For instance, many species display a green star as a throat marking.

Hippeastrum papilio (the IBS logo) uses green to advantage by contrasting the maroon-red blazes on its flower segments against the cool mint-green of the segments' base color. This gives a striking combination.

Hippeastrum cybister, one of my favorite *Hippeastrum* species, along with having one of the most bizarrely shaped flowers of all, has, in some forms, stamens with long, swooping, green filaments and pistils with even longer, even more swooping, green styles.

Hippeastrum papilio is a winter-grower tending to be evergreen and a late winter to early spring bloomer while *H. cybister* is a mid-spring to late spring bloomer and a summer-grower. Both are easy to grow and both will hybridize with other species, I'm told, including some hybrids. Some of Fred Meyer's recent work has been with *H. cybister* which can produce seedlings with a spidery look and in many colors.

MULTIPLE SCAPES, MULTIPLE FLOWERS

As I mentioned previously, my bulb of 'Lemon-Lime' grew three flower scapes with 6/4//4 flowers its first year. While hybridizers always have sought more flowers per bulb it's not so uncommon nowadays to find three flowering scapes emerging from one's bulbs, even when the bulbs themselves are not of the giant or massive type which are sold so extensively in Germany and The Netherlands. (Sometimes, I'm told, one can even buy the giant bulbs from street vendors in these countries!)

Another phenomenon worth mentioning here is that some hybrids don't know when to stop flowering. I've seen at least one hybrid that, according to the hybridizer, was in flower almost year-round, sending up one flower scape after another. This did not seem to affect the bulbs' vigor as they continued to grow and flower on and on. The bulb(s?) probably would have continued in this manner but the hybridizer felt this "everblooming" characteristic undesirable—"Who wants an amaryllis bulb that blooms all the time?", he questioned—so the cultivar was destroyed.

It's worth noting, however, that this "everblooming" characteristic is possible. In fact it very nearly occurs in at least one species as well. The Doran Collection availability list (mailed to IBS members along with *The Underground* newsletter, Vol. 2, No. 1, Autumn, 1996) has this to say about about item #90. *Hippeastrum blossfeldiae* : This form has flaming orange flowers, always with six flowers per umbel. Large bulbs can flower any time of year." While *H. blossfeldiae* is not a constant flowerer, this form is a *frequent* flowerer capable of blooming more than once a year.

DOUBLE AMARYLLIS

Double amaryllis also have been with us a long time. I'm noticing more of them being available lately. It seems one either likes the doubles a lot or loathes them with equal intensity; there's little room for neutral ground here.

Currently available from many commercial sources and catalogs are varieties such as 'Double Picotee', double white with a red edge, 'Lady Jane', double salmon with white streaks, 'Pasadena', double red with white streaks and 'Double Record', double clear white with red streaks.

Amaryllis Inc. lists twelve doubles: 'Mary Lou', 'Double Record', 'Rainbow', 'Lady Jane', 'Judy Weston', 'Red Peacock', 'Sharon Double Picotee', 'Yock', 'Pasadena', 'Aphrodite', 'Jewell' and 'Blossom Peacock'.

I'm one person who likes double hippeastrums. A lot. So was the late Ivan Kenney. Ivan hybridized for doubles and produced some beauties, none of which, to my knowledge, he introduced. For many years we were privileged to see some of Ivan's creations at our annual amaryllis shows sponsored by the Southern California Hemerocallis and Amaryllis Society. He often took blue ribbons and even higher prizes for his double hybrids.

Ivan told me that there are some tricks to producing double hippeastrums. He said that, as a rule of thumb, if you cross two doubles, you might get up to 50% of the resultant seedlings producing *some* doubling in the progeny's flowers. Even so, very double flowers are not all that common among the seedlings.

On the other hand, if you cross a double with a single the doubling falls off sharply and you would be lucky to get up to 25% of the progeny's flowers showing some doubling. *Very* double flowers are even less common among the seedlings of these crosses than when two doubles are crossed. If you are interested in hybridizing for double hippeastrums you might bear these figures in mind.

And by the way, don't be intimidated by people who "simply can't stand" double amaryllis. I've noticed that when an especially beautiful double appears on the show benches in all its glory such "I can't stand doubles" people are often standing in front of its many-petalled flowers, jaws dropped, and just as much agog as anybody else.

In general, double-flowering hippeastrums seem to be more popular than ever. If you like them, be proud: hybridize them, grow them and show them. Their flowers are different...and wonderful.

COOLER GROWING TYPES WHICH ALSO CAN TAKE THE HEAT

Hippeastrum papilio is the only species I grow which normally produces its leaves and flowers during the winter without special treatment. It's healthy, vigorous, a good multiplier and, if you have more than one clone, a heavy seed-setter, too. I grow mine in pots sitting right out in the open where the bulbs get drenched with the winter rains, frosted by temperatures in the 20's (F), cooked in the occasional winter/spring heat waves (temperatures in the 80's and 90's (F) during February, March, April and May this year).

At the same time, this species—which has a tendency to try to remain evergreen (yet with leaves looking quite frazzled or even completely gone by the end of our summers)—also can take the Southern California summer heat. I give mine a little water from time to time during the summer and very little protection winter or summer. Perhaps some frost protection if the temperature is forecast to drop below 25°F. An altogether wonderful species.

For those who enjoy flower arranging, the fantastic coloring—maroon-red on cool lime-green—of *H. papilio*, while at first glance appearing not to combine with any other color, actually combines with almost *every* other color. I once took a vase of flowers containing two flowers of *H. papilio* with a dozen red, pink and yellow tulips and some Blue Ribbon Dutch Iris in to work with me. Talk about a spectacle! I had people coming into my office throughout the day asking me for bulbs, not of the more brightly colored tulips and iris but of the *Hippeastrum papilio*. Somehow the brilliant colors of its vase-mates brought out the green and muted red-maroon of the *H. papilio*.

Unlike many more brightly colored flowers, I find that *H. papilio* looks especially good under fluorescent lights which seem to enhance its green color.

NEW FORMS

You can go wild with hippeastrum forms. In addition to what we normally think of as the usual hippeastrum shape, as exemplified by the Dutch and South African hybrids, there are trumpet shapes, crimped shapes (*H. papilio*—it's a "Hipp" with hips), wide petals, flared petals, narrow petals (*H. cybister*—petals that are little more than threads), variants (*H. aulicum* var. *stenopetalum, H. reticulatum* var. *striatifolium*), huge flowers, mid-size flowers, small flowers (*H. mollevillquensis, H. miniatum*), tiny flowers (*H. blumenavium*), you name it, this genus probably has it. Then there are the umbels, some with two, four, or six flowers, I've seen umbels with eight flowers. Scapes can be tall, short, intermediate.

Many hippeastrum flowers have scents; all I've smelled so far are delicious. Colors range from scarlet reds to blued reds to rose, pink, lavender, white, yellow, green, blends, contrasts, patterns, markings, stripes, lines, spots.

There are so many directions in which the genus *Hippeastrum* can be taken by hybridizers that, even with the many people who already have worked within this genus, I'm surprised more don't. With the best care it is not unheard of to have flowers from seed in less than two years. With less care, from three to seven years.

Two suggestions come to mind at this point. For me, my hip-

peastrums have been gross feeders, so feed them grossly, that is, a small amount, frequently. Every watering is not too much if the fertilizer is diluted sufficiently. In fact, some of the best bulbs I've seen were fed in exactly that manner. The other suggestion is about pest control. Mealybugs, scales, the ants which feed from mealybugs and scales, viruses, fungi, bacteria, and other pests attack hippeastrums as they do so many plants. But with "Hipps", the plants can go downhill with lightning speed. Establish a routine of frequent periodic inspection and clean up any problems before they gain a foothold. Like fertilizer, a little inspection frequently can go a long way towards the health and growth of your plants.

TIPS AND TECHNIQUES

Micropropagation techniques of many plants, including hippeastrums, are well covered in the third edition of **Plants From Test Tubes**, [reviewed on page 200]. According to the authors, micropropagation itself is not difficult and can be done in an improvised laboratory set up in a home or apartment. Included is a formula called *Hippeastrum* media, a starting point for those of us who are interested in this kind of "gardening". Getting the techniques right may not be such a hurdle but keeping things sterilized could be. Nevertheless, by following the rules step by step and keeping all sterilized, one should be able to obtain good results in fairly short order.

Of course tried and true bulb multiplication techniques such as raising species from seed, bulb cuttage, twin-scale multiplication and natural bulb multiplication are all techniques the hippeastrum enthusiast should become familiar with.

I pass along a self-pollination technique which I only recently learned about. It might help those of you who are interested in self-pollinating your favorite *Hippeastrum* species if you have only one clone. While most species are self-sterile, if you take pollen from another hippeastrum—any you have available—and cook it in your microwave oven for several seconds, say from 10 to 20 seconds, then apply it to the stigma of the flower along with its own pollen, sometimes, I'm told, *sometimes* your single clone can be made to produce seeds from its own pollen. The idea here is that the tiny amounts of slightly different chemicals in the foreign, microwaved-thus-dead pollen trick the plant into believing its own pollen is not its own but from another clone. (Yes, I've tried this trick, but only once. While it didn't work for me that time, there's no reason it might not work next time. Certainly it's worth trying, at least, if you're desperate to get seeds from a species which is definitely self-sterile and you have only one clone.)

RECENT HYBRIDIZING WORK

From 40,000 hippeastrum seedlings, former International Bulb Society Executive Director Fred Meyer, has made 70 cultivar selections which are now being propagated for the cutflower, dry bulb and forcing markets. According to Fred, the cutflower market wants bulbs which grow flowers such as the trumpets, the spiders and miniatures. These must be easy of culture and flowering and have all the other characteristics one might expect from good cutflower cultivars, such as disease resistance, ease of propagation, wide color range in colors the market demands, good shipping qualities, etc.

My own research, admittedly non-exhaustive, indicates that the cutflower market tends somewhat to chase fads but also to a large extent relies on the "tried-and-true". Successful new cut-flower cultivars include clear colors, new forms, novelties of many types, tall, tough, flexible, non-breaking flowering stems (scapes), and flowers with perfect, non-breaking, hard-to-bruise segments

The dry bulb market wants bulbs which can bloom with two or more spikes even after having endured the trauma of early harvest, root deprivation, months of dry, cold storage and special early-bloom treatment. In addition, consumers demand pleasing colors, novelties, new cultivars from time to time and ease of culture to flowering especially during that all-important first year of growing.

The forcing market wants cultivars which can be pre-planted and sold, pot, potting mix and all, for early blooming within six to eight weeks from time of purchase. These are grown and sold by the thousands for bloom during the Christmas holidays. Such cultivars must possess the qualities of beauty and ease of growth which consumers demand. Weakness of any sort is quickly discovered. A hybridizer must do intensive testing of cultivars before they're put on the market. Flaws are not tolerated.

The color range of the Meyer hybrids runs the gamut of all the colors we're familiar with, plus lavender-blues, greens, purples, lavenders and spotteds. The flower size goes from the maxis we all know and love so well to minis 5cm in diameter.

Some of the Meyer hybrids have variegated leaves, six, eight or ten flowers per scape, multiple scapes (up to five per bulb) and, fragrance. I am especially grateful for this last attribute as fragrance, a desirable consumer benefit, is all too often ignored by hybridizers.

Many of Fred Meyer's new hybrid hippeastrums are being propagated for the three markets even now, so we should see some of them emerging into consumers' hands and lives within the next five years or so. In the meantime he continues to work with hippeastrums and has another 40,000 seedlings coming along from which more selections will be made.

Alan Meerow, the International Bulb Society's scientific review

editor and fellow IBS Board member, is another modern hippeastrum hybridizer. Alan does much of his work at and for the University of Florida. He is focusing on hybrids that grow well outdoors in the southern part of Florida.

Alan first concentrated on making primary (F_1) hybrids with *Hippeastrum papilio* and a number of other species including *H. brasilianum* and *H. reticulatum* var. *striatifolium* along with *H. fragrantissimum, H. lapacense* and *H. cardenasianum.* He has built upon this foundation of primary hybrids by crossing among them and by introducing genes from tetraploid Dutch hybrids that perform well under Florida conditions. This year, he submitted his first hybrids for University of Florida release: two landscape cultivars for use outdoors and three cultivars for the cutflower forcing market.

The University of Florida is propagating other selections from among Alan's hybrids and will be releasing these cultivars to the various consumer markets within the next five years.

Alan reports that he, too, is generating cultivars with fragrance, unusual color, high bud and scape count and variegated foliage. He and Fred Meyer have maintained close communication about their respective breeding programs and have even exchanged pollen at times.

CONCLUSION

Hippeastrum hybridizing continues to be alive and well among hobbyists and professionals alike. Abundant rewards in knowledge and pleasure still await those with discipline and skill. There is also the possibility of financial reward in the form of royalties. While being paid money for one's hybridizing work is a numbers game (usually, one needs to grow huge numbers of seedlings to get a good one or two worthy of introduction), nevertheless, there's always the possibility that your lucky number might come up.

All things considered, it's an exciting time for those of us who love hippeastrums.

ACKNOWLEDGMENT:

I thank Len Doran, friend and mentor, for his generous guidance on *Hippeastrum* species. He saved me a great deal of research. In addition, I thank Fred Meyer and Alan Meerow for so generously sharing information with me about their current hybridizing work.

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MODERN DAY PLANT EXPLORERS, Part Two

GUY WRINKLE

Our plane landed in Johannesburg in the evening. The customs check was easy and straightforward, a welcome relief from the customs officials of some of the countries I have visited. About an hour later, we took another flight to Cape Town which brought our total traveling time to about 24 hours. I would much rather spend a day in 100°F heat and 100% humidity than stay on a plane that long. We checked into a nice hotel for the night and were off next day to look for plants.

Finding plants can be extremely easy or nearly impossible, depending on how rare the plants are that you are looking for, and whether or not you are interested in whole groups of plants or just one particular species. There are many incredibly interesting plants in most parts of South Africa that, if you don't restrict yourself too much, you can't miss. My main interests were cycads and succulents which usually are found in drier areas. The first place we visited was the Cape Nature Reserve and Cape Point where the Atlantic and Indian Oceans come together. This is a very wet area but still full of interesting species. There we found *Protea cynaroides* (the national flower of South Africa) in bloom along with several geophytic orchids including *Disa* and *Eulophia* species. As wet as it was, there were also several succulents such as *Crassula* and *Euphorbia* species. Going higher up the slopes of nearby Table Mountain it gets wetter and wetter but there were still geophytic orchids and many bulbs. It was also interesting to see large numbers of baboons this close to town.

When people ask me about the dangers of the wildlife in Africa, the baboon and ostrich are at the top of my list. I have been able to find many of larger animals in Africa but I have never had any real trouble with them. Baboons and ostriches can mean trouble, however. The male ostrich is very aggressive and can rip your abdomen open with his powerful legs and large claws—as a result they are highly respected by the local people. The trouble with baboons is that where they are found near large groups of people, they lose their fear of humans and can bite. I once saw a Xosha woman in the Eastern Cape of South Africa have a bag of chips she was holding snatched by a female baboon. She responded by hitting the animal in the face! She did not, however, get her chips back as the animal ran away. There is no way I would have hit that animal and I doubt if she would have either if her chips had been snatched by a large male baboon.

When I first went to South Africa, I had no interest in bulbs at all but that soon changed. I think that most people tend to be

impressed by the flowers of bulbs but I have found that there are many species that are attractive (or weird, some people say!) when not in bloom. Several species of *Gethyllis* (which do have beautiful flowers, too), some *Albuca* and several other genera fall into this category. There also are many larger species of bulbs that are of interest to succulent collectors. Examples of these include *Boophane, Brunsvigia* and *Haemanthus*. During the course of seven trips to South Africa, I have found many interesting bulb species that remain unidentified to this day.

The second day, we visited the Karoo Botanic Garden and its curator at that time, Bruce Bayer. Mr. Bayer is probably the world's leading expert of the genus *Haworthia* and is very knowledgeable regarding the genus *Oxalis* and many other groups of plants. The Karoo Botanic Garden is at Worcester, more or less northeast of Cape Town—inland and much drier than Cape Town. In fact, the word Karoo means "the dry land" in one of the local languages.

We were fortunate to be given some of Mr. Bayer's very limited time to be shown some of the Karoo species in habitat. One particularly interesting species was *Lithops comptonii.* This is one of the members of the mesemb family [Mesembryanthemaceae] which mimic rocks and as a result are hard to find. Many of these species are localized in their distribution and, in addition, very cryptic. I had not been interested in mesembs but started looking for them anyway. After all, how hard can it be to spot plants when you are walking among them? Right? I could not find even one and only was able to see one when Bruce practically pushed my face right into the plants.

I since have found that a number of plant species, especially geophytes can go undetected even if one is standing right on top of them. This was the case when I later went to find *Euphorbia ernestii* in the Eastern Cape. I knew I was at the correct locality because I was there with someone who had seen the plants in that location before. As we were getting into the car to leave, I saw one right next to the car in ground we had been tromping over. This is not only the case with small plants like *Lithops* and some *Euphorbia* species but some larger plants as well. A friend once took me to see *Encephalartos altensteinii,* a large cycad. This species grows in the grasslands of the eastern Cape, often next to rivers. The grass is about a foot high and the cycad often is at least six feet tall. I could not see the first plant until I was about ten feet from it and it was pointed out to me because the plants are hidden in the very narrow strip of forest the grows along the river. Needless to say, finding geophytes in their dormant season when everything is under ground is not easy.

This brings up another problem one encounters when looking for plants in places such as southern Africa which have summer and winter rainfall areas. The south western part of South Africa is a winter rainfall area whereas the rest of the country gets rain in the summer or all year around. Not only must this be taken into account when growing plants from these climatically diverse areas, but it is a critical factor in reestablishing plants for cultivation in the northern hemisphere where the seasons are reversed. For example, a winter-growing plant sent from South Africa to the USA in June will be starting to grow but will encounter summer conditions here at that time and may stop growing and possibly die. As you probably can see, there are several possible combinations for potential disaster here. Some species (oftentimes larger species) don't seem to mind when you move them whereas others (many irids for example) are especially sensitive to this rapid change of hemispheres and, therefore, seasonal growing conditions.

WHAT IS A PLANT COLLECTOR?

Dylan P. Hannon
Claremont, California

We often hear the term "plant collector". But how do we define that term? To some it conjures up visions of the intrepid plantsman slogging through impenetrable jungles or over hostile deserts to reach a mountain where an elusive orchid or *Alstroemeria* may reside. To others it means simply "one who collects" or "amasses" plants for personal pleasure; no doubt many readers are a little of both. In the following I relate aspects of my own collecting, in the sense of "amassing", in an effort to communicate certain issues and details I believe are important to our hobby and which seldom find their way onto the printed page.

Most of the plants I have grown have been held in containers, with some very enjoyable gardening during briefer periods when it was feasible. Gradually, a rather large assemblage of things came together, with a major emphasis on succulents and geophytes. Before a cross-country job-related move in 1986, my admittedly relentless pursuit of rare plants had created a collection of about 1000 different species or taxa. Such "collecting" often came at the expense of achieving high marks in school (jokes about not having a personal life also fall in the same general area). Currently, after several years back home in California, my collection has surpassed previous levels and there is much record-keeping in addition to watering and all of the other familiar chores.

Even with a more modest collection there are important advantages to keeping good records. It is difficult for me to remember such a time, but around 1980 I was a frequent visitor to the biology greenhouses at the University of California, Santa Barbara (UCSB) and it was here that I got my introduction to record-keeping and, in effect, to curating a collection of living plants. Through the guidance and patience of Mr. John Bleck, who managed these fascinating and diverse teaching and research collections, I learned why it is important to keep some sort of initial 'diary', or log book, for accessions and also to have a card file to keep track of these same accessions. Some people or institutions keep two card files—one for known living plants and the other for dead accessions. Cards are only made up for plants which have "made it"—cuttings which rooted, seeds which germinated (and usually only after the first transplanting), etc. Unlike the accession book, cards are filed alphabetically by genus. Even when accessions are logged in the book using a blank line between each entry, and always using only one side of each page, it is often difficult to write in much pertinent information later. Thus the more easily supple-

mented card file serves to accomodate a variety of useful information. Such data might include propagation records (with dates, methods, success rates, etc.), records of whom a particular species or cultivar was shared with, garden performance, photographs taken, etc.

Before sharing a few salient points involved in record-keeping, I suspect that some readers have already struck upon the logical extension of the above system, that is, computer databasing or even using a simple word processor. There are many different ways to approach the subject electronically and I do not wish to expound upon a subject about which I know too little. There are good reasons to have an accession book/card file system in place as an additional or alternate (or sole) way to keep information in a convenient form. Storing data on paper, or "hard copy", is more durable than electronic means in important ways; both may be damaged or destroyed by fire, but an accession book (always using pencil) can weather accidents involving water and will not ever be "tweaked" by power surges or suffer malfunctions that discs or computers can be subject to. Record books should never leave the house since they are irreplaceable; however, it is advisable periodically to make photocopies of the pages and store the copies in a safe place such as a safe deposit box. If total disaster strikes both house and garden, and one later feels up to the task of rebuilding a sizeable collection, records of whom plants were shared with would be invaluable.

The system I use consists of a cloth-bound (not spiral bound) college notebook, preferably with narrow ruling (more lines per page). The basic procedure involves entering new accessions by lot. For example:

Park Seed Co., S. Carolina 15 April 1996
96133 *Worsleya rayneri* (25 seeds, $4.95)
96134 *Rhodochiton atrosanguineum* (20 seeds, $2.95)
96135 *Paramongaia weberbaueri* (5 large bulbs, $5.95ea.)

Correspondingly, the accession number should be written on the tag or seed packet at the same time. The accession number consists of the last two digits of the current year followed by three consecutive numbers which restart each year. Three digits is a good place to start (*e.g.*, 96001) since it would not be unreasonable to expect to exceed 99 accessions in one year; I've yet to reach 1000 entries for one year (and I hope I never do!) but have exceeded 800 more than once. As for the year, some prefer to write it "96.001" or "96/001", etc. You may wish to create your own numbering system.

For the title of each lot, *i.e.*, the source, it is useful to note whether that source sent you the plants by mail or whether you visited that person or place. When problem-solving it can be especially useful to tie a particular plant to a particular trip or visit

and such careful notation can enhance the process of elimination.

One of the convenient aspects of using an electronic database system is that one may have an entry, or field, for both the name a plant was obtained under and a further field(s) for name changes. As we all know, name changes do and will continue to occur, so it is good to make some provision for it. Lightly crossing out the entry name in pencil and writing the new one directly above it will serve in many instances. For more complicated cases, the card file is the place to make additional notes. If you have read this far, I don't suppose I will frighten anyone off by also suggesting that it can be useful to record just who it was who suggested the "correct" name (including yourself) or name possibilities for unnamed plants.

One of the most important aspects of keeping information with accessioned plants has to do with species or even cultivars which are of documented, wild origin. At the very least, this might be reduced to a collector's name and his or her field collection number. Often this data (*e.g.*, Lavranos 25436) is all that is available without going to some lengths to discover exactly where the plant was collected in the wild. Some catalogues offer collections of a certain species under such numbers; sometimes this is done to discern different collections of the same species. It is highly desirable to obtain the information associated with a number at the time you are obtaining the plant material. If only a number is available, take care not to confuse accession numbers with field numbers; usually they are easily differentiated.

Knowing the wild origin or provenance of a plant has a variety of important applications. Firstly, it is information that will never change, no matter what name may be assigned to the plant in question. In reading the various references one might research in order to name a plant or confirm or clarify its identification, there are often (one hopes) significant discussions regarding the geographical distribution of the genus or group in question. Taxonomic puzzles which do not readily conform to our simplified species concepts can, at least in some cases, be better comprehended in terms of biogeography. Often, geographical patterns which "make sense" can help us mentally to break down an otherwise complicated picture and to put into context the possible life histories of plants we enjoy contemplating.

Secondly, knowledge of a plant's wild origin gives us insight into how that plant may best be cultivated or, just as importantly, how to keep a plant through its dormant season. In my own experience, it usually is difficult to obtain anything in the way of locality information beyond the name of the nearest town or city. If it is possible to acquire this information without annoying the source too greatly, by all means obtain data such as elevation, slope aspect,

soil type, vegetation, etc. Beyond the obvious horticultural advantages to having this information at hand, there is, for some at least, an intellectual pleasure in knowing about a plant and where it comes from that makes the relationship between plant and custodian more enjoyable.

Lastly, the keeping of field collection information with one's plants has important considerations when it comes to reaching more sophisticated stages of exchanging with others who grow plants. Here I am refering particularly to botanic gardens and researchers, whose living plant resources are typically well-documented in this regard and who are loath to trade with amateurs who are not likewise oriented. Since I currently work in a botanic garden and have worked in the past as a research assistant in another garden, I know well the feeling that some people in these institutions may have at times when they are pelted with inquiries from "outside" by hobbysits or collectors who do not share their religious zeal for the documentation of living plant collections. This, of course, is especially true when it comes to questions as to how one might obtain a particular species or any number of species that apparently are unobtainable in the "trade". If you are addicted to searching out impossibly rare and obscure (and not even showy!) plants, as I am, exchanging with such parties is one way to advance one's collecting. It is, in fact, possible to penetrate this mysterious barrier between botanic gardens and researchers and the rest of us, and in my opinion it is imperative that we do so in this time of rapidly disappearing natural resources. The key is to upgrade our own collecting methods and to think more often of the larger picture of keeping and improving the tremendous diversity and wealth of plants in cultivation today. It has been ackowledged in public writings by a few modern botanic garden administrators that the greatest wealth of cultivated plants has always been, and probably always will be, in private hands. In a similar vein, some of the most significant holdings within botanic gardens have originated from private individuals donating seeds or other material they have collected either abroad or locally. When such materials are carefully collected and documented, they can be useful to a researcher working on a particular group, for instance the numerous aroids which have thus found their way into the extensive collections of Dr. Thomas B. Croat at Missouri Botanical Garden. In exchange, a researcher or garden is often willing to part with cuttings or seeds desired by the donor.

There is a relatively small aspect of collecting or gardening which is a critical one when considering the "associated information" upon which we have just heaped so much impotance. How many readers have not had problems with labels? This is always

Nerine...continued from page...89

Nerine platypetala: from swampy areas (which get severe frosts) in the southeast Transvaal; deciduous, summer growing; thin leaves to 50cm long,; pink flowers flushed rose-red at the base with a central red streak.

Nerine pudica: from southwest Cape; deciduous, winter growing; 25-35cm flower spikes with pink [or white with red stripe] flowers.

Nerine pusilla: from Namibia. No additional information found.

Nerine rehmannii: from the Transvaal and Swaziland; deciduous, summer growing; 1 or 2 filiform leaves to 9cm long, white flowers on 15cm peduncle, flowers have very crisped perianth segments.

Nerine sarniensis: from the southwest Cape; deciduous, winter growing, bright red flowers in autumn.

Nerine transvaalensis: from the Transvaal; deciduous? or evergreen, but comes from a summer rainfall area; leaves present with the flowers, pale pink flowers with recurved perianth segments.

Nerine undulata: from the eastern Cape on steep slopes in partial shade; almost evergreen (the leaves die back at flowering time, but emerge again soon thereafter); pale pink flowers with strongly crisped margins on stems to 45cm, bulbs multiply profusely.

Then there are several controversial species not listed by Arnold and de Wet, but which are recognised by others as distinct species:

Nerine alta (now *N. undulata* according to Arnold and de Wet): from the Eastern Cape wetlands; deciduous, summer growing; hysteranthous, petals very fine and tending to roll into tubes but strongly crisped giving the impression of very dainty spidery flowers; darker pink than N. undulata (information from Cameron McMaster).

Nerine angulata (not in Arnold and de Wet *et al*): from seepage areas in the eastern Cape; almost evergreen; filiform but robust leaves; large flowers with upper petals arranged vertically in a fan shape in autumn; egg-shaped seeds. (information from Cameron McMaster).

Nerine filamentosa (now *N. filifolia* according to Arnold and de Wet): from the eastern Cape in shallow soil in rock fissures; deciduous, summer growing; short fine filiform leaves, a flattened umbel of rose-pink to red flowers with strongly recurved segments and extremely long filaments, flowers in late summer. (Information from Cameron McMaster).

Nerine flexuosa—confusion reigns supreme! According to Graham Duncan's book **Bulbous Plants of Southern Africa**, this species comes from the Eastern Cape, is evergreen and flowers in late autumn. According to Arnold and de Wet, this species is the same as *N. humilis*, which is from the southwest Cape and is deciduous. According to the Agricultural Research Center, this species is the same as *N. undulata*!!!

an ongoing issue—never completely resolved—in botanic gardens, and can be just as frustrating for private collectors. As I have tried to convince certain friends, it is not possible in the end to "keep it all in your head"—a sound method of labeling brings some peace of mind at the same time it makes various operations easier. There are a variety of "security measures" one may take here, the most important of which is to abandon and replace all cheap "plastic" labels.These are usually made of polystyrene which degrades rapidly in the presence of sunlight. For pennies more one can buy plastic-looking labels which are vinyl-based and can last for years. As a further precaution, in my collection the labels are generally buried to within a few millimeters of the upper end so they can be seen and accessed if need be but will not be casually broken off or knocked out. In a strictly horticultural sense, it should not be necessary to have the full name of the plant in view on the label. As a further step some growers place a second label at the bottom of the pot when repotting and this can be especially useful for geophytes in containers. In the garden, it seems difficult to argue against the tried and proven method of using heavy gauge aluminum labels that have the name and accession number etched, or preferably, impressed into them. These are then attached to a sturdy metal stake and placed consistently on one side of the plant throughout the garden.

This is an exciting time to be collecting, growing and propagating plants. For me it is often more rewarding to share a plant with someone else who has been coveting it for years than to obtain something for myself which I have similarly desired, and this too is part of being a plant collector. Perhaps this feeling results because in disbursing a plant we have sent it toward its "cosmic destiny" whereas a plant obtained has reached an end. The very positive human interaction is probably the greatest factor of all—I cannot imagine the proverbial last man on earth being a collector of any description. Sound record-keeping methods assist in this process of sharing and can add greatly to the calibre, quality and enjoyment of plant collecting. If we wish also to increase the productive exchange of plant materials between botanic gardens and private individuals it is up to us, the latter, to raise our own standards and create the future we desire.

DON'T THROW AWAY THOSE SEEDS UNTIL YOU'RE SURE

Charles Hardman
Baldwin Park, California

When does one call it quits with seeds that just sit in the pot and don't germinate? You give them the best of conditions, the tenderest of care, and what do they do?—they return your kindness by refusing to send up their first leaves. A month goes by, two months, a season, sometimes a year or more while you wait and wait and watch and watch for those first tiny wisps of green.

What's the problem?

There could be many problems...or none. While it's always possible that seeds you've purchased or which have been given to you may have been baked (sitting on top of an electrical or heating appliance), broiled (out in the hot sun too long), frozen (in an airplane's cargo hold), crushed (poorly packaged mail), too old or subjected to who knows what indelicacies before arriving in your more merciful hands, there may yet be a reason to keep them a while longer: Your seeds may very well be alive and just waiting for the proper conditions to trigger them into growth.

The compact, beautiful magenta-violet flowered *Romulea hantamensis* is a champion non-starter. How well I remember that day many years ago when I decided I had waited long enough for its seeds to germinate. Three years plus several months was really too long, I thought. I lifted the potful of its seeds and was just in the process of tipping it over when my eyes caught a few slivers of green. What ho! Seedlings?

Yes, they were seedlings, sure enough. Apparently the cold winter still in process—I remembered seeing ice crusting the soil in the pot one morning after a cold night only a few weeks previously—had signaled the seeds that this was their time to get a move on and they had responded.

The seeds grew vigorously from that moment of their near destruction and my potful of *R. hantamensis* now continues to bloom for me every year, its lovely flowers chiding me for my lack of faith in the species' ability to get itself started.

Since that experience I've had others tell me they've had similar trials of patience with this species. So why is this?

We get a clue from Miriam P. De Vos's wonderful revision of the South African members of the genus *Romulea*. In writing about *R. hantamensis* she says: "This rare species apparently has a very local range on somewhat moist, loamy ground, at an altitude of 1,500 metres on the Hantam mountain.....". If my calculations are correct, one thousand five hundred metres finds this species

growing at an altitude of nearly a mile. The weather at that height probably gets chilly, even icy, during winter. So seeds of this species wait until they receive the correct "It is now moist and cold—you may germinate" signal from Mother Nature before birthing themselves into their not altogether friendly environment.

Ordinarily I think of the flat, black-seeded amaryllids as wanting heat in order to grow. This is a prejudice, of course, and like most prejudices it's a generalization which does not always hold true. When I first planted my very flat, very black seeds of *Pamianthe peruviana* I just knew they would germinate within a few weeks because they were flat and black and therefore "looked" like they would. I held this attitude in spite of John Bryan's caution in his book which reads "Seed can be sown as soon as ripe; it takes about one year to germinate." Planted in March, they didn't germinate until the following January, ten months later. January is our coolest month here in Southern California. I believe the coolness had something to do with the germination of the *Pamianthe* seeds, although Mr. Bryan also cautions that "winter temperatures (should) never go below 50°F..." and winter temperatures around here always go considerably lower than that. (The plants are kept in a protected area which doesn't quite freeze, however.)

Seeds of *Phaedranassa chloracra*, another flat, black-seeded amaryllid, planted on July 12, 1996—I thought I was doing the right thing—began growing during our cool October, three months later. They were still germinating through our even cooler December as the nights continued to hit temperatures in the thirties and even the twenties Fahrenheit (+4°C to -5°C). The plants grew well outside throughout the following winter defying the note I have on these seeds which indicates: Grow warm.

Bomarea saligna planted on July 13, 1996 also showed no signs of life until the weather turned cool. Its seeds began to emerge in late December. *Bomareas* are viney relatives of *Alstroemerias*. As *Alstroemerias* demand cool soil temperatures in order to grow, expecting *Bomareas* to wait until cool weather to germinate is quite in keeping with what we ought to expect from them. Or is it? The two sets of instructions I find for growing this genus both indicate that the vines grow during the summer and, while one set of instructions advises growing them in a warm greenhouse, the other indicates moderate greenhouse temperatures. My advice: Give your plants the care they ask you for under your local conditions and which a bit of experimentation tells you is right. At any rate, don't be surprised if seeds begin germinating at curious times or after an extended period of time.

Cyclamen seeds are notorious for germination rates varying from excellent to virtually non-existent. They may require from

three weeks to three months or even more to germinate, and success after four or five years is not unheard of, although most of us might not have the patience, let alone the expected life-spans, to wait out such tardiness. Warm water soaks, detergent water soaks, warm detergent water soaks, planting without soaking and other rituals performed on cyclamen seeds down through the ages all have their adherents. The best technique seems to be to plant the seeds as soon as they are taken from the just-ripened seed capsule, before they get a chance to dry completely and go into dormancy. This works fine with seeds one has raised oneself, but with purchased or gift seeds, already dormant, it's best to try one of the accepted forms of soaking mumbo-jumbo until you find the one that works best for you. (One method: soak dry seeds for 24 hours in warm water to which a drop or two of detergent has been added. Drain. Soak again for 24 hours in plain warm water. Drain. Plant. Keep cool and moist until seeds germinate.)

Plan to soak your iris seeds before planting, too. Both cyclamen and iris seeds, and no doubt lots of of others, tend to have growth inhibitors in them once the seeds go dormant. A bother to us growers, of course, but it's Nature's way of protecting her babies until conditions are just right. Naturally it's best not to argue with the Old Gal, but if you have her children's best interests at heart, she'll sometimes allow you to trick their seeds by soaking out their growth inhibitors. One account of soaking Iris seeds which I read was written by a man who put his seeds in a mesh bag, tied the bag to a water faucet, turned the faucet on so that it dripped slightly and left the seeds hanging in the dripping water for several months. It worked. With the growth inhibitors flushed out of his seeds they came up in record time and a new (I wonder!) gardening technique was revealed to the world. (An old sock or stocking would work just as well, I suppose, as long as it was made of artificial fiber which could endure being wet for so long without rotting.)

I've noticed that *Romulea monadelpha* and, to a certain extent, *R. sabulosa,* often give only partial germination the first year they are planted but nearly all their remaining seeds germinate during the second growing season.

Fresh seeds of *Anigozanthos manglesii* (not a bulb but the plant behaves similarly) just won't germinate for me whereas seeds held dry in a seed envelope kept in a drawer for from one to seven years germinate easily—yes, you read that right: seven years.

And then there are the seeds which germinate but don't tell you about it for a long time. Case in point: *Lycoris. Lycoris* seeds are fleshy when ripe and they must be planted as soon as they're ripe and while they're still fleshy. To allow them to dry is to kill them. To allow them to dry partially isn't a good idea either as they don't

rehydrate easily. Unlike seeds of some other fleshy-seeded amaryllids such as *Nerine, Crinum, Brunsvigia* and *Amaryllis belladonna* which can lie on the surface of the soil and still germinate, *Lycoris* seeds must be planted here in dry Southern California, that is, submerged beneath the surface of the moist soil. There, each seed can germinate, send out roots and form a tiny bulb, all with nary a sign of a leaf appearing above the surface of the soil. Under the soil the baby bulbs wait out their first growing season, then their first dormant season, and finally during the bulbs' second growing season up come their leaves sometimes to the surprise and always to the relief of the person who planted them.

This behavior is called hypogeal germination. Whether it holds true for all *Lycoris* species, I don't know. I do know it has held true for the seeds I have planted, although, in a classic case of the exception that proves the rule, occasionally a first-year bulb has sent up a tiny leaf defying Mother Nature's "No *Lycoris* leaves until the second growing season" rule.

Seeds of *Clivia miniata* and its hybrids also must be planted away, out of the light. *Clivia miniata* seeds can take many months to germinate if you just lay these big fleshy seeds on the surface of the soil. Many would rather die—and do!—rather than germinate unless their need for darkness—and, in my experience, coolness—is met. Light tells *Clivia* seeds to hold off germination. Be sure you cover these seeds with a half-inch (lcm+) or so of soil mix so that light can't get to them. Another way to germinate *C. miniata* seeds quickly is to put them in moistened soil mix in a plastic bag and keep them in the crisper of your refrigerator until they germinate. Then plant them, roots and seeds slightly buried, and keep them in a shady, cool spot. The leaves of *Clivia* plants require shaded light but *Clivia* seeds do well with no light at all until they have formed their first leaves.

I'm sure many readers will have had similar experiences with bulbous species other than the ones I've mentioned here. For those of us who are fascinated by seeds and the flowering plants they become we may not be pleased with such lengthy germination periods but at least we can take comfort in the fact that even lotus seeds do not require a thousand years to germinate although it's a fact that one or two have germinated even after such a lengthy entombment.

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A SOURCE LIST OF GEOPHYTIC PLANT MATERIAL

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This list is intended as a resource for members of the IBS and is in no way an endorsement of the businesses listed. Whereas I have had personal experience and/or correspondence with the majority of those suppliers listed, I cannot vouch for the reputations and/or reliabilty of all listed below. I was able to get a firm toehold on this list several years ago with the help of Barbara Barton's book **Gardening by Mail: A Sourcebook** and include it here as an initial reference.

It is intended that this list be updated and expanded yearly with the aid of members and suppliers who wish themselves to be known. Information on quality of service, time taken to receive orders, accuracy of naming and quality of products would be beneficial. Please send addresses and/or catalogs to Dave Casebier, at the above address. In particular there are few South American sources, and I would like to add more such sources which could be used by members.

SEEDS

B & T World Seeds
Whitnell House, Fiddington, Bridgwater, Somerset TA5 1JE, England
David Sleigh Fax & Tel 0278-733209
Huge, very extensive lists of seed, organized by type (the first you will get is a list of lists: alpine, perennial, trees etc. Ask for list number 6 (bulbs); they also will try to fill requests.

Chiltern Seeds
Bortree Stile, Ulverston, Cumbria LA12 7PB, England
Tel (01229) 581137 Fax (01229) 584549
Large seed supplier, lists some *Bomarea* and *Stenomesson* species and has had *Pamianthe peruviana* in the past.

John Watson and Anita Flores de Watson
24 Kingsway, Petts Woods, Orpington, Kent BR5 1PR England
Tel (0689) 822494
Wild collected alpine seed from South America, *Rhodophiala* sp.

Martin Kunhardt
Wahroonga, PO Box 144, Merrivale 3291, Republic of South Africa
Seed of *Cyrtanthus, Brunsvigia, Watsonia* and high veld bulbs, also hybrid *Cyclamen* and *Streptocarpus* seed.

Monocot Nursery
'Jacklands', Jacklands Bridge, Tickenham, Clevedon, Avon BS21 6SG, England
M. R. Salmon
Extensive list of *Narcissus,* Araceae, *Colchicum, Puschkinia, Scilla* and *Crocus,* as well as other dwarf bulbs. Collector number and locality supplied with many of the offerings.

Silverhill Seeds
18 Silverhill Crescent, Kenilworth 7700, Republic of South Africa
Rachel and Rod Saunders Tel (021) 762-4245 Fax (021) 797-6609
Large listing of South African plants, including extensive bulb section. Can obtain amaryllids at times.

BULBS

Amaryllis, Inc.
PO Box 318, Baton Rouge LA 70821 U.S.A.
Ed Beckham Tel (504) 924-5560, (504) 924-5421
Mostly *Hippeastrum* hybrids, but some species of *Hippeastrum, Habranthus, Lycoris* and other bulbs.

Avon Bulbs
Burnt House Farm, Mid Lambrook, South Petherton, Somerset TA13 5HE, England
Chris Ireland-Jones Tel (0460) 242177
Wide-ranging list of hardy bulbs with both species and hybrids.

Broadleigh Gardens
Bar House, Bishop's Hull, Taunton, Somerset TA4 1AE, England
Christine Skelmersdale Tel (0823) 286231
Specializes in dwarf bulbs: *Crocus, Fritillaria* species, tulips and iris, hyacinths and daffodils as well as other dwarf rarities.

Cambridge Bulbs
40 Whittlesford Road, Newton, Cambridge CB2 5PH, England
Norman Stevens Tel (0223) 871760
Extensive list of hard-to-find, hardy , small bulb species, also offers *Tecophilaea cyanocrocus, T. cyanocrocus leichtinii,* and *T. violacea.*

Cape Flora Nursery
PO Box 10556, Linton Grange, Port Elizabeth 6055, Republic of South Africa
Tel (041) 732096 Fax (041) 733188
Good list of amaryllids, including *Brunsvigia* and *Cyrtanthus,* and irids from the Cape region.

Clivia Breeding Plantation
4-28, Kurodo Mobara-city 297, Chiba Prefecture, Japan
Yoshikazu Nakamura Tel/Fax 0475-23-5444
Clivia species and hybrids, including 'Vico Gold' and variegated leaf forms.

Charles Craib
PO Box 67142, Bryanston 2021, Gauteng, Republic of South Africa
Fax 27-11-462-1418
List of seed grown South African bulbs. Seedlings are usually two years old or more and are healthy and vigorous. List includes species of *Albuca, Amocharis, Crinum, Haemanthus, Nerine* and more. He specializes also in geophytic *Pelargonium* species.

Croft Wild Bulb Nursery
PO Box 61, Stutterheim 4930, Republic of South Africa
Tel (0436) 31330 Fax (0436) 31931
Specializing in bulbs of the Eastern Cape region.

David Sampson
Oakdene, Street End Lane, Broad Oak,
Heathfield, East Sussex, TN21 8TU, England
Tel (0435) 864382
Primarily an alpine grower, but has some *Lilium, Iris* and *Trillium* species.

Diggers Garden Company
105 Latrobe Parade, Dromana VIC 3936, Australia
Tel 05987-1877

Flowers and Greens
PO Box 1802, Davis CA 95617, U.S.A.
Roy Sachs Tel. (916) 756-9238 Fax (916) 756-1201
A hobby out of control. Sells own *Alstroemeria* hybrids in unusual and nice color combinations; sometimes has warm-growing species for sale.

Glenbrook Bulb Farm
28 Russell Road, Claremont, TAS 7011, Australia

Grant Mitsch Novelty Daffodils
PO Box 218, Hubbard OR 97032, U.S.A.
Dick & Elise Havens Tel (503) 651-2742
The cutting edge in daffodil hybrids, still searching for the true red-on-white. These are luscious, exotic bulbs for those of us who live in the tundra. Catalog is $3.00 U.S.

Greenlady Gardens
1415 Eucalyptus, San Francisco CA 94132, U.S.A.
Tel (415) 753-3332
Large list of South African bulbs and hybrids. Very good selection.

Guy Wrinkle Exotic Plants
11610 Addison Street, North Hollywood CA 91601, U.S.A.
Tel (310) 670-8637 Fax (310) 670-1427
Rare plants that are in short supply from the wild—cycads, caudiciforms, rare succulents. I have seen his list and it is quite impressive. Some plants are collected in the wild but more and more are nursery propagated.

Imbali Bulbs
PO Box 267, Auckland Park 2006, Republic of South Africa
Robert and Andrea Orr Fax 011-27-486-1527
Wonderful list of South African bulbs, both from the Iridaceae and Amaryllidaceae, good selection and reasonable prices.

Jacques Amand Ltd.
The Nurseries, Clamp Hill, Stanmore, Middlesex HA7 3JS, England
Tel (981) 8138 Fax (981) 6784
Well known nursery for bulbs, somewhat pricey but has interesting and rare material, including *Tecophilaea cyanocrocus* var. *leichtinii,* and *T. cyanocrocus* var. *violacea.* They now have an American supplier and an 800 phone number, but the tack-ons, dollar-pound exchange, additional shipping and phytosanitary certificates can be expensive.

Jim Duggan Flower Nursery
1452 Santa Fe Drive, Encinitas CA 92024, U.S.A.
Tel (619) 943-1658
Primarily South African irids and some *Lachenalia* species. List varies somewhat from year to year. Now has the stock of BioQuest International.

John Scheepers, Inc.
PO Box 700, Bantam, CT 06750, U.S.A.
Tel (203) 567-0838 Fax (203) 567-5323
Same owners as Van Engelen (which see), with a similar listing. Primary difference is in quantities and pricing.

Joy Plants
Runciman Road, Rd 2, Pukekohe East, New Zealand
Terry Hatch Tel 1649-238-9129
Sells a wide variety of bulbs; nerines are a specialty.

Kelways, Ltd.
Barrymore Farm, Langport, Somerset TA10 9EZ England
Old firm that sells iris and hemerocallis, but famous for hybridizing some of the best peonies known. They grow and sell over 600 varietis of peonies.

Kelly's Plant World
10266 E. Princeton, Sanger CA 93657, U.S.A.
Herb Kelly, Jr. Tel (209) 294-7676
List is U.S. $1.00. He sells a broad selection of *Canna* and *Crinum* hybrids; also has a large collection of choice *Lycoris* hybrids.

Lousiana Nursery
Route 7, Box 43, Opelousas LA 70570, U.S.A.
Ken, Albert and Dalton Durio Tel (318) 948-3696 or 942-6404
Catalog is U.S. $3. Large listing of choice *Crinum* hybrids and some rare bulbs which thrive in the southern U.S.A.

Lowlands Nursery
P. O. Box 9, Kei Road 4920, Republic of South Africa
Ms. Joan Bursey Tel (0432) 820731 or 820730 Fax (0432) 820731
Sells a number of cycads but also has a good number of bulbs for sale at low prices. My experience with her has been excellent.

McClure and Zimmerman
P.O. Box 368, Friesland WI 53935, U.S.A.
Tel (414) 326-4220 Fax (414) 326-5769
Large list of choice bulbs, varying slightly from year to year.

Monocot Nursery
'Jacklands', Jacklands Bridge, Tickenham, Clevedon, Avon BS21 6SG, England
Extensive list of *Narcissus, Araceae, Colchicum, Puschkinia, Scilla* and *Crocus,* as well as other dwarf bulbs.

Paul Christian – Rare Bulbs
PO Box 468, Wrexham, Clwyd LL13 9XR, United Kingdom
Species-oriented, extensive list of hardy bulbs and some more tropical species. Careful attention is given to customers and to accurate names of the plants. Summer list: £0.60, DM 1.50, FF 5.00; also a winter list.

Pine Heights Nursery
Pepper Street, Everton Hills, Queensland 4053, Australia
Tel (01617) 353-2761
Sells *Calostemma lutea* and *C. purpurea,* also *Sprekelia, Crinum, Habranthus, Zephyranthes, Hippeastrum* and other subtropical amaryllids.

Plantation Bulb Co.
Box 159, TyTy GA 31795, U.S.A.
Tel (912) 388-999
Large listing of *Crinum* & *Hymenocallis* species/hybrids, other tropical bulbs.

Potterton and Martin
The Cottage Nursery, Moortown Road, Nettleton,
Caistor, Lincolnshire LN7 6HX, England
Tel and Fax (1472) 851792
An alpine grower. Extensive list of dwarf bulbs, both hardy & temperate.

R. Seawright
201 Bedford Road, PO Box 733, Carlisle MA 01741-0733, U.S.A.
Tel (508) 369-2172

Very large list of *Hemerocallis* hybrids and species—over 600. Excellent display gardens and growing fields with very high quality material.

Robinett Bulb Farm
PO Box 1306, Sebastopol CA 95473-1306, U.S.A.
Expanding list of Cape and native California bulbs.

Rust-en-Vrede
P.O. Box 753, Brackenfell 7560, Republic of South Africa
Hendrik van Zijl Tel (021) 981-4515 Fax (021) 981-0050
Established, reliable supplier of South African bulbs and seeds. Extensive list from a wide range.

Russell Graham, Purveyor of Plants
4030 Eagle Crest Road N. W., Salem OR 97304, U.S.A.
Tel (503) 362-1135
Primarily a perennial grower of North American native plants, has some *Lilium, Trillium* and *Sanguinaria* species

Southwestern Native Seed
Sally and Tim Walker
PO Box 50503, Tucson AZ 85703, U.S.A.
Sells seeds of indigenous Southwestern plants, including *Tigridia, Calochortus* and *Zephyranthes.*

Sunburst Bulbs
P.O. Box 183, Howard Place 7450, Republic of South Africa
Tel (021) 531-9829 Fax (021) 531-3181
Species and hybrids of South African bulbs; very variable list.

The Botanist
16 Victor Close, Green Point NSW 2251, Australia
Tel 04367-7524

The Green Goblin
PO Box 39422, Queensburgh 4070, Kwazulu-Natal, South Africa
Greg Pettit Tel/Fax 031-463-1983
Grower and collector of African bulbs, especially *Crinum* species and hybrids. Willing to trade bulbs for those he is interested in.

The New Peony Farm
P.O. Box 18235, St. Paul MN 55118, U.S.A.
Ken Crossley Tel (612) 457-8994
Peony hybrids and species, sources of which are very few.

The Plumeria People
P. O. Box 820014, Houston TX 77282-0014, U.S.A.
Richard and Mary Helen Eggenberger Tel (713) 496-2352
A few assorted tropical bulbs, *Zephyranthes* and *Habranthus* species.

Tzitzikama Nursery and Seed Supply
PO Box 1069, Plettenberg Bay 6600, Republic of South Africa
Tel (04457) 48896 Fax (04457) 48791

Van Engelen Inc.
313 Maple Street, Litchfield CT 06759, U.S.A.
Tel (203) 567-8734 Fax (203) 567-5323
28 page catalog of Dutch bulbs at very reasonable prices.

Woodbank Nursery
RMB 303 Kingston TAS 7150, Australia
Tel 00239-6452

COMMERCIAL AND GARDEN SOURCES

B & D Lilies
330 "P" Street, Port Townsend WA 98368, U.S.A.
Bob and Dianna Gibson Tel (206) 385-1738 FAX (206) 385-9996
Cutting edge Oriental, Asiatic, and Aurelian lily hybrids; large number of *Lilium* species; also sells daylily and *Alstroemeria* hybrids.

Borboleta Gardens
15980 Canby Avenue, Faribault MN 55021-7652, U.S.A.
Dave and Jeanne Campbell Tel (507)334-2807
Hybrid lilies, iris, daylilies and peonies.

The Bulb Crate
2560 Deerfield Road, Riverwoods IL 60015, U.S.A.
Tel (708) 317-1414
Primarily lily and iris hybrids.

Cascade Bulb and Seed
PO Box 271, Scotts Mills OR 97375, U.S.A.
Dr. Joseph C. Halinar Tel (503) 873-2218
Offers their own seeds/ bulbs of lily, *Allium* species and hybrids, *Hemerocallis*.

Cruickshank's, Inc.
1015 Mount Pleasant Road, Toronto, Ontario, Canada M4P 2M1
Tel (416) 750-9249 or (800) 665-5605
Daffodil and tulip hybrids and species; the only supplier on list who sells *Narcissus cyclamineus*.

Crutchers Colors
18900 South Pear Road, Oregon City OR 97045, U.S.A.
Ken Crutcher Tel (503) 631-3656
Grows and sells their own hybrids of Asiatic, Oriental and Trumpet lilies.

The Daffodil Mart
7463 Heath Trail, Gloucester VA 23061, U.S.A.
Brent and Becky Heath Tel (800) 255-2852 Fax (800) 420-2852
Sells daffodil, tulip and other garden bulbs, most hardy, some not, as well as some hybrids not readily available. Prices on some items are less expensive than most sources, especially for the high end items.

Dutch Gardens
PO Box 200, Adelphia NJ 07710, U.S.A.
Tel (908) 780-2713 FAX (908) 780-7720
Commercial Dutch importer for garden varieties; also some species.

Lindel Lilies
5510 239th Street, Langley, BC V3A 7N6, Canada
Linda and Del Knowlton Tel (604) 534-4729
Hybrid Oriental, Asiatic, and trumpet lilies and some species.

Messelaar Bulb Co.
PO Box 269, County Road, Route 1A, Ipswich MA 01938, U.S.A.
Pieter Messelaar Tel (508) 356-3737
Commercial Dutch importer for garden varieties.

The Lily Garden
36752 S. E. Bluff Road, Boring OR 97009, U.S.A.
Judith McCrae Tel (503) 668-5291
Lily hybrids and a nice selection of species.

Van Bourgondien Bros.
PO Box 1000, 245 Farmingdale Road, Rt 109, Babylon NY 11702-0598, U.S.A.
Tel (800) 622-9997 FAX (800) 669-1228
Primarily garden varieties, but occasionally has an odd bulb of interest. Not known for their customer satisfaction. Free catalog.

Van Dyck's Flower Farms, Inc.
PO Box 430, Brightwaters, NY 11718-0430, U.S.A.
Tel (800) 248-2852
Commercial Dutch importer for gardens. Good service & quality for the price.

SOCIETIES WITH A SEED EXCHANGE INCLUDING GEOPHYTES

These societies are absolutely the best way of acquiring the difficult to locate species

Alpine Garden Society
Membership Secretary, AGS Centre
Avon Bank, Pershore, Worcestershire WR10 3JP, England
Publishes a nice quarterly. Seed list usually includes some *Rhodophiala, Alstroemeria* and *Bomarea* species.

Botanical Society of South Africa (BSA)
Kirstenbosch, Claremont 7735, Republic of South Africa
Publishes a quarterly journal and an annual seed list from Kirstenbosch National Botanic Garden.

North American Lily Society
Executive Secertary-Treasurer
PO Box 272, Owatonna MN 55060, U.S.A.
Dr. Robert Gilman
Publishes a news quarterly; extensive seed list of lily species and hybrids.

North American Rock Garden Society
Executive Secretary, P. O. Box 67, Millwood NY 10546, U.S.A.
Publishes a quarterly journal and good seed list including *Narcissus, Romulea* and *Roscoea* species.

Scottish Rock Garden Club
20 Gorse Way, Formby, Merseyside L37 1PB, Scotland
Ian Aitchison, Treasurer
Publishes a good, biannual journal. Extensive seed list with a number of South American species that seems to be supplementary to the AGS with little overlap.

The Clivia Club
Koos, Geldenhuys, Treasurer
P.O. Box 74868, Lynnwood Ridge 0040, Republic of South Africa
Publishes a bulletin now and then; Clivia species, hybrids and sports.

The Indigenous Bulb Growers Society of South Africa (IBSA)
3 The Bend, Edgemead, Capetown 7441, Republic of South Africa
Paul F.X. von Stein
Publishes an annual, a newsletter and a fairly variable seed list.

Book Reviews

IRISES, A Practical Gardening Guide by Karen Glasgow, 1997. Timber Press, Inc., The Haseltine Building, 133 SW Second Ave, Suite 450, Portland OR 97204-9743. 104 pp. 100 color photos, 7 x 10 inches (17cm x 15cm). Softbound. $19.95.

Karen Glasgow, who died before this book went into production, accomplished an admirable job by condensing the genus *Iris* into a book of just over 100 pages. With a knack for simplification, Glasgow divided the genus into two groups, rhizomatous and bulbous, and continued further breakdowns from that point.

The book is generously illustrated with one hundred color photographs of *Iris* species, varieties and hybrids and landscape shots. Landscape shots should be inspirational, I feel, and many of those which appear thoughout this book truly are photos which can get the blood boiling to create similar scenes.

Yet, I doubt this is the book originally envisioned by the author. It is apparent that the author's death in 1994 caused an abrupt shifting of gears and priorities by subsequent contributors. Most noticeable is the fact that there are details lacking.

For instance, while Pests and Diseases and Propagation are chapters and soil and moisture needs are covered under the genera and species' descriptions, the book has insufficient information on fertilizing. As "What kind of fertilizer should I use?" is one of the questions I'm most frequently asked when talking about plants, the nutritional needs of irises could have been explored more fully.

While there are many *Iris* species pictured, *Iris variegata*—a species upon which the author places special emphasis by saying, "It is to this gaudy little iris (sic) more than to any other species that we owe the wealth of loveliness that we find in modern Tall Bearded Îrises"—is not shown. After such glowing praise, the reader deserves to see "this gaudy little iris (sic)".

In addition, there are details overlooked. For instance, the picture of a brilliantly clean lemon-yellow *I. reichenbachii* on page 35, clearly does not match its "muddy yellow" description on the facing page. And, even after reading the two descriptive paragraphs on *I. unguicularis* (syn. *I. stylosa*), I was left wondering why the author refers to it as "the most desirable member of the entire genus." Perhaps because it blooms from autumn throughout winter. But then, I'm not really sure and the two pictures showing varieties of the species on page 78 are unconvincing.

The index is incomplete. Try looking for the words "pests", "diseases" "propagation" or "fertilizer". You won't find them. The first three words do have brief chapters devoted to them, however.

It's obvious that the author was a devoted fan of *Iris* and her first chapter, "Iris, the year-round flower" (sic), makes it clear that, in most of our gardens, we could, by selecting the proper species, have *Iris* flowers nearly the whole year through.

A conversion chart (metric to imperial) on page 101 is a good idea and I see that Timber Press is including a similar chart in more of its published works these days. A wise move.

This book will be most helpful to gardeners who want a quick, overall view of the genus *Iris*.

Charles Hardman

PLANTS FROM TEST TUBES, An Introduction to Micropropagation by Lydiane Kyte and John Kleyn. Third Edition, 1996. Timber Press. 240 pp, b/w photos and illustrations. 7¼ x 10¼ inches (20cm x 27cm). Hardcover. $29.95.

"Cloning", both the word and the deed, continue their frontal assaults on the world's languages and mores. By now—May, 1997—most of Planet Earth's human population must know that plants and animals—including mammals—can be cloned. In fact, laws are being written even as I write this prohibiting the cloning of people.

Therefore, barring a dramatic change in human nature, we can expect to see human clones popping up all over the place any day now.

But the cloning of plants has been going on by natural means for eons and by micropropagation in laboratories for decades. This book, now in its third edition, continues to inform and amaze us about this wonderful process called micropropagation. Talk about miracles!

There is a lot of basic science in this book. Fortunately, it's science written on the level of the dedicated amateur plant enthusiast.

In fact, the authors encourage tissue culture "gardening" as a perfect hobby for the elderly or the handicapped. If you're thinking "small business" along about now, you're right: the authors discuss such a venture. A suitable lab, it seems, can be set up without a great deal of expense or room and valuable plants reproduced for sale. The key to it all is sterilization, from one's equipment right down to the air likely to contact one's plants-in-the-making.

The first section of this book provides an overview and history of its subject, then carefully details items such as the laboratory, media, explants, transfer, growing on, business, etc. Following this section are details of the micropropagation of specific genera.

Many "bulbous" plants are detailed, complete with growing

media formulas. *Hippeastrum, Arum, Freesia, Iris*—two formulas, one for rhizomatous, one for bulbous—Lilies, *Hemerocallis, Begonia*, they're all here along with many other "bulbous" genera. Contents and index (Why isn't the word "explant" listed in the index? Because it's used so many times throughout the book, maybe?) are here, of course, along with a comprehensive bibliography, a fine glossary, a useful Formula Comparison Chart and four appendices which cover Metric Conversions (metric to imperial), The Microscope..., Professional Organizations and Suppliers.

This is an altogether wonderful book for budding plant scientists or gardeners who seeks to expand their gardening knowledge.

Charles Hardman

GLADIOLUS IN TROPICAL AFRICA, Systematics, Biology & Evolution by Peter Goldblatt. 1996. Timber Press, Portland OR. 7¾ x 10¾ inches (20 x 27cm). Hardbound. 321 pp. $39.95

This much-needed book finally makes sense of a fascinating group of cormous plants. That this group of plants was so confused is nicely explained in a good historical introduction. The last revision of this group was almost 100 years ago!

The African continent is large—covering an immense area. This book covers the 83 *Gladiolus* species found in sub-Saharan Africa down to, but not including, the South African species. Nineteen new *Gladiolus* species are described for the first time.

Peter Goldblatt has studied African bulbs extensively in the Iridiaceae and has many great books to his credit, including **The Genus Watsonia** (1989) and **The Moraeas of Southern Africa** (1986). ***Gladiolus* in Tropical Africa** is a continuation of the detailed study of plants in this diverse plant family.

After a fascinating fourteen pages of historical information the book continues with 24 pages of morphology, 12 pages of relationships, phylogeny and classification, 5 pages on development of garden hybrids, 4 pages on the phytogeographical data on the plants, and an 11 page key to the species. The line drawings by John C. Manning are excellent. Most species are illustrated by a line drawing.

The 41 color photos are good to excellent and many are of plants in habitat. A major fault of the book is that the 16 pages of color photos have no page numbers, are not keyed to the text, and are not included in the index so as to quickly find the photo of a certain species.

Each species listed includes synonymy, eponymy, distribution map, description (including chromosome number if known), diag-

nosis & relationships, variations, history and selected specimens.

Some of the *Gladiolus* species included in this book are very widespread on the African continent yet are not even known in cultivation. Why? The spectacular flowered *G. dalenii* is seldom seen in cultivation but is an extremely reliable and colorful bloomer—and is now shown to have many color forms.

The author's revision of the genus into only two subgenera (*Ophiolyza* and *Gladiolus*) is reasonable and workable.

One species, *G. crassifolius*, flowers twice a year. This could be used to hybridize future cultivars with a longer flowering season. Another species, *G. decoratus*, has twice had its chromosome number determined to be triploid—a most unusual situation. Some species would be wonderful to try in cultivation: *G. erectiflorus* (all color forms), *G. verdickii* (all color forms), *G. sericeovillosus* subsp. *calvatus, G. watsonioides, G. longispathaceus, G. sudanicus*....

The fact that *Gladiolus dalenii* has over 30 synonyms is one indication that the author put an incredible amount of work over a long time into this book. ***Gladiolus* of Tropical Africa** is an absolute must for all who study, grow, hybridize or enjoy this fabulous group of flowering plants.

Michael Vassar

MOSS GARDENING Including Lichens, Liverworts, and Other Miniatures by George Schenk. 1997. Timber Press. 264 pp. 97 color photos. 6 x 9 inches (15cm x 23cm). Hardcover. $34.95.

As the title indicates, mosses, one of Planet Earth's longest-running success stories, are the focus of this book. Around for about 400 million years, mosses are still evolving, even though there are already some 15,000 species spread from the Arctic to the Antarctic.

At first discovery, Moss Gardening appears to be a whimsical approach to gardening. Most of us, not surprisingly, think "flowering plants" when the word "garden" is mentioned.

But moss is more than "just another pretty face" in one's garden. Mosses and their companion cryptogams (tiny plants that reproduce by spores), tiny liverworts, lichens, lycopodiums and certain of the selaginellas, lend an aura of age and stability to a garden. This book, along with expanding your appreciation of these plants, will also enlarge your vision of them, for mosses are not simply junk plants to be weeded out or consigned to throw-away garden corners. Mr. Schenk's 97 color plates dramatically illustrate that mosses should be more widely used even to the point of square

yardage as in moss lawns. (Beautiful!)

Moss also can form a lovely frame for bulbs peeking up or bursting out through (Plate 53, pg. 127). Bulbophiles definitely should consider experimenting with this unique approach to groundcover under their bulbous plants.

Bonsai and its derivatives would be the poorer were it not for mosses and Plate 60, page 147 shows the simplest of tiny gardens: moss partially covering a rock "island" sitting in a bowl of water: tiny, tranquil, tender, a perfect focus for just unwinding or deep meditation.

Along with its excellent text, the many photographic representations of mosses and lichens especially—but also liverwort, lycopodium and selaginella—make this book especially useful for those of us who like to "see" as well as "read about" plants. Mr. Schenk has assembled these photos with an eye for both art and function.

I would like to have seen a general index included (an "Index of Mosses and Other Bryophytes" *is* included). But the book is so well written and so well photographed that perhaps others might find such unnecessary.

Mr. Schenk is to be commended for tackling such a rarely discussed gardening subject and for producing such a practical, beautiful result therefrom. This book rates a thumbs up from me.

Charles Hardman

PLANTS FOR THE FUTURE, A Gardener's Wishbook by Jerome Malitz. 1996. Timber Press. 224 pp. 70 color photos. 10 black/white figures, 2 maps 6 x 9 inches. Hardbound. $34.95.

The opening words to Chapter 1 set the tone and scope of this book: "All gardeners are pie-in-the-sky visionaries—sanguine optimists who see in every winter storm the moisture to prime a flower-filled spring."

No less an optimist is Mr. Malitz himself, for the speculations in this book frequently provide wonderful stretches for one's imagination. A fair share of them would have seemed like dunderheaded foolishness only a few years ago. But now, the techniques the author relies on to fulfill—eventually—many of his and humanity's hopes for developing the plants of our future are already well established science.

Further on, the author writes, "In the chapters that follow, I will describe various strategies that promise to yield radically new plants." (Pg. 18.) Chapters 2 and 3 provide the reader with some science basic to the remainder of the book.

Lest my readers' eyes glaze over at the mention of the word "science", let me add that this is pretty basic modern plant science explained admirably and simply in only 18 pages.

Then, on page 41, we're already into the chunky part of this magical stew with Chapter 4, called "Engineering New Plants" which discusses techniques available to plant scientists such as tissue culture, cloning devices, cell fusion, chimeras, mutations, in vitro fertilization, embryo rescue, haploidy and gene transfer all explored briefly and in wonderfully simple language.

I couldn't have said it better myself, might be your reaction to Chapter 5. This chapter sums up many of the desirable traits we all wish for in all our plants but only find in varying degrees, usually insufficient, in each.

This completes the book's Part 1 and by page 65 we're into Section II, A Wishlist" Oh boy!, does Mr. Malitz have a wishlist! From generalities such as increasing cold tolerance in tropical species to increasing heat tolerance of those from nearer the poles, to salt and pH tolerance to increasing drouth tolerance to specifics such as daylilies which deadhead themselves (lose their spent flowers without having to be hand picked) to improving the beauty of currant (*Ribes*) bushes to improving orchids, poppies, ferns, roses, trees and bushes and, well, you get the picture.

I can think of no finer gift for a young person with an interest in plants or even the makings of a plant scientist. As for those of us who are older and just want to keep up, there's no finer gift you can give yourself than these speculations on the future of plants, some of which, no doubt eventually will come true.

Charles Hardman

GROWING BULBS, The Complete Practical Guide by Brian Mathew. 1997. Timber Press, Portland OR. 156 pp. Hardcover. $29.95.

What is this fascination with things subterranean which many gardeners experience? Bulbs, corms, rhizomes and tubers are plant structures not normally seen, yet, many a gardener, including myself, will turn up their noses at plants which lack them. Brian Mathew, not being a psychiatrist, wisely has avoided a psychological analysis of such behavior in his book, GROWING BULBS. It is the only omission in his wonderful book. It is a book for bulb lovers from a bulb lover.

Rather than emphasizing a description of the bulbs themselves, GROWING BULBS is a practical guide to the cultivation of bulbs. The scope is broad, encompassing hardy and tender bulbs, summer

and winter growers, as well as tropical species. There is something for everybody, for the beginner and for the accomplished grower.

The introductory chapter on understanding bulbs is a masterpiece of lucid writing, avoiding scientific jargon, yet providing the reader with a deep understanding of the nature of bulbous plants. It is followed by chapters on the cultivation of bulbs and bulbs in the garden. Both of these chapters will satisfy the needs of serious gardeners as well as apartment dwellers with postage-stamp size plots.

In other chapters Brian Mathew has distilled his wisdom and guides the reader on topics such as labeling and recording data, smoke treatment and sowing seeds; topics rarely covered in other bulb books.

An informative description of pests and diseases of bulbs prepares the reader to deal with common and unusual causes of bulb loss. It is knowledge gleaned from personal experience. The advice is practical, clear and concise.

Approximately one third of the book is dedicated to the basics of bulb growing. It is followed by a major listing of some 100 genera, providing basic culture for each. It is here that Brain Mathew clearly stands above all those who previously wrote about bulbs. It is a guide gleaned from Mathew's own collection. The pages are filled with invaluable advice. I wish I had had this book when I first started growing bulbs. It would have prevented many disappointments.

GROWING BULBS is a must-have book for the serious bulb grower. It also will satisfy the beginner and set him on a proper course. The book is well illustrated and wonderfully written. If you thought that bulbs were simply lumps of plant tissue growing below the garden surface, prepare yourself for a rare treat. Brian Mathew writes with wit and a love of the subject.

Charles Gorenstein

THE PROPAGATION OF ALPINE PLANTS AND DWARF BULBS by Brian Halliwell, 1992. Timber Press. 193 pages, 45 figure illustrations, 6½ x 9½ inches (16cm x 24cm). Hardcover. $24.95.

Propagation of plants is not only fun, it's sheer magic, as anyone who has ever rooted a cutting or taken bulblets off a gladiolus bulb knows. To multiply one's plants is to multiply one's wealth. So learning how to increase favorite plants is a must for any gardener.

The first part of this book explains with detailed text and ample illustrations the topics of seed propagation, vegetative propagation

and special techniques such as the various forms of bulb, corm, rhizome and tuber reproduction. Cutting, coring, scooping, scoring, scaling, twin scaling, they're all here and detailed with just the right combination of simple language, adequate descriptions, time-tested techniques and good illustrations.

The second part of the book is an A to Z listing of plants titled, appropriately enough, "A-Z Listing of Plants", a nearly comprehensive listing of genera available for growing in the alpine or rock gardens with a brief description of each plant listed.

Three good appendices entitled "Societies", Sources of Plants and Seed" and "Conversion Tables" (metric to imperial), a bibliography and an index round out this worthwhile and helpful addition to any gardener's library.

This book is a must for serious alpine propagators and a useful addition to the library of any dedicated bulbophile. While published in 1992, the book contains timeless information. However, a call to the publisher informed me that there are only about 150 copies remaining. At present, there are no plans to republish. So if you want your copy, get it now.

Charles Hardman

The Gardener's Guide to Growing Fritillaries, by Kevin Pratt and Michael Jefferson-Brown. 1997. Timber Press. 160 pages, 7½ x 9¾ inches [19 x 24.8cm]. $29.95

The introduction aptly sets the tone and purpose of this book: it is designed primarily to be a practical guide on cultivating fritillaries, to give some background on the genus and to inspire us to grow and to develop and enthusiasm for these lovely and varied flowers. In the course of this book, Kevin Pratt, nurseryman and holder of the British National Collection of over 100 species of *Fritillaria,* and Michael Jefferson-Brown, a garden writer, gardener and Royal Horticultural Society judge, fill the bill on all three counts.

Those who don't already grow fritillaries may be unaware of the diversity of flower colors, patterns, species variability and plant sizes (from mere centimeters to 1 meter tall) so we get a glimpse of these beguiling features in the first chapter, "The Fascination of Fritillaries". The increasing availability of species after World War II has made plants more accessible in greater variety than before and in this chapter the authors set forth a list of candidate species for a "starter collection".

The second chapter covers *Fritillaria* botany and distribution, the distribution being rather generally described as the "temperate parts of the northern hemisphere", and "into the drier, harsher

areas of Asia Minor and California". A map providing an overview of distribution would be appreciated, as would a discussion of the origins of the genus name and a whirlwind synopsis of early species discoveries. The introduction to the botany of the genus covers several key points, including the importance of nectaries as diagnostic aids, and the variety of shapes, openness and reflextion of tepals, the role of style and bulb type and shape in identification, habitat and factors that set the genus apart from *Lilium* and other somewhat similar genera. Those readers already thoroughly familiar with the distribution, habit and growth of a range of *Lilium* will get the most out of this chapter, as the authors make frequent references to various aspects of lily botany. The importance of nectaries and bulb type to *Fritillaria* identification reminds me of *Calochortus*, and in a future update of this book I would love to see a key to the sections and species, including notes on and diagrams of nectaries.

In chapter two, three pages of useful drawings of style forms, bulb forms and seed pods illustrate some key points, and they augment the paragraph on factors of greatest importance in classifying species. The genus *Fritillaria* is divided into six sections and the authors provide a handy table of species in each section.

Chapter three, "Buying and Cultivating Fritillaries", is filled not only with lovely color plates of blooms of many species, but also with sound advice on seeking out bulbs at small nurseries, horticultural shows, botanic gardens and through plant socieies. Pratt and Jefferson-Brown cover how to select the best bulbs from available stock, when to buy, what care to take in handling and storing the bulbs, and where to place your treasures in the harden. This chapter thoroughly covers soil preparation, pH, drainage, planting time and depth and mulching or topdressing. The authors also briefly but competently cover care, division and dormancy issues, but the best part of this chapter is the excellent and thorough treatment of basic pot culture of fritillaries. A detailed section on forming raised bulb beds and bulb frames for greater drainage, moisture, rodent and climate control includes tips on using screening, wire and plastic mesh for a variety of purposes including containing very small "rice grain" offsets.

The recurring emphasis on using common sense and adjusting instructions to suit your particular climate, soil and landscaping is refreshing. This approach to culture should prove encouraging to new growers and gardeners outside Britain.

The fourth chapter, "Plant Associations", covers choices of companion plants to consider when landscaping with fritillaries. It contains suggestions for planting fritillaries in temperate pasture or meadow-like gardens, at edges of woods, in rock gardens and

beds, interplanting with heathers and dwarf deciduous or very open evergreen shrubs, among drier-growing ferns or in a Mediterranean planting. Pratt and Jefferson-Brown mention not only specific taxa but also general plant categories (such as sub-shrubby plants, smaller lilies, deciduous trees) and contrasts in plant form and habit, which allows the reader greater freedom of imagination when adapting landscaping suggestions to local conditions and plant material availability.

A competent discussion of the practical and philosophical pros and cons of propagation by seed and by vegetative means leads off chapter five, "Propagation and Breeding". The authors describe physical appearance, harvesting and viability of seeds, brief storage and sanitation tips and pollination methods. They give good instructions on seed sowing from post-harvest timing to soil mixes, moisture and the first two to three years of care and transplanting young bulbs. Gardeners outside England may wish to refer to Charles Hardman's article, "The Famed John Innes Composts Revealed at Last" (*The Underground* 1:1, Autumn 1995), for more background on the John Innes mixes used in this chapter. The chapter contains a short, sensible guide to propagation, care and feeding of bulblets and bulb scales. It closes with a section on breeding which covers basic hybridizing technique and lists nine species crosses and their results.

Chapter six, "Fritillaries in the Wild", defines four general categories of habitats/growing conditions where fritillaries are native. It gives an overview of several areas and some of the typical species found there. Note that "Great Valley of California" probably is a reference to California's Central Valley or San Joaquin Valley. "People and Their Plants", the seventh chapter, introduces three Fritillaria growers: an alpine and bulb grower, a plant explorer who has visited wild populations of fritillaries in several countries, and an enthusiast/nurseryman. These three aficionados share cultural advice, habitat background and species descriptions.

In contrast to much of the first part of this book, chapter eight, "Fritillaries in North America", is slightly more technical in nature, discussing and describing at least 15 of the 19 North American species, their habits and similarities to other species. It includes a diagram on proposed relationships between 23 taxa. "Showing Fritillaries" (chapter nine) covers the rewards, requirements and strategies of entering pots of fritillaries in flower shows and discusses how to grow and transport winning entries.

The largest chapter, "A-Z List of Fritillaries", encompasses an alphabetical list of many *Fritillaria* taxa, their sections, style types, geographical origins, descriptions and specific cultivation and landscaping notes.

The authors thoughtfully included a one-page glossary of basic botanical terms, an index and six appendices indispensable to gardeners: A-"Where to See Fritillaries" (in Great Britain), B-"Where to Buy" (bulbs and seeds), C-a list of common synonyms, D-"Fritillaries for Specific Locations" (lists of species for various landscaping uses), E-"Country of Origin" (lists species by region of origin, *e.g.* Europe, Eastern Mediterranean and Asia Minor, Asia and North America), and F-"Plant Characteristics and Requirements" (a table of species listed alphabetically, their flowering periods, height, color, ease of culture and soil condition in summer). I hope that when this book is updated the authors will include a list of recommended papers, reference works and other literature for those wishing to do further study on this remarkable group.

The Gardener's Guide to Growing Fritillaries is a lovely, practical book packed with notes on culture and landscaping that both bulb enthusiasts and general gardeners will enjoy. The culture chapter alone is worth the price of admission. Though I cannot grow many temperate species in my Mediterranean climate garden, this book has rekindled my desire to rediscover the odd and beautiful fritillaries from California and the Middle East.

Elisabeth Lassanyi

CYCLAMEN, A Guide for Gardeners, Horticulturists and Botanists by Christopher Grey-Wilson, Timber Press, Portland. 192 pages, 140 color photos, 40 line drawings, 12 maps, 7½ x 10 inches. Hardbound. $39.95

The genus *Cyclamen* has yielded one of the world's most important tuberous crops loved by professional and amateur growers alike. With only twenty currently recognized species, the genus is still a tricky one fraught with missteps for the unwary plant scientist. It's not surprising that so few people have been willing to tackle this genus in recent years. Yet Christopher Grey-Wilson has written and published two books on cyclamen within the last decade. Both have been occasions to be celebrated and this new book is, in many ways, an improvement over his 1988 book.

The earlier work focused on the botany, taxonomy, cytology, history, culture and geography of the species. The current book includes that information (sometimes in a different arrangement) and much more.

As the two books are on the same subject and by the same author, some comparisons are in order. The earlier book contained 147 pages, 12 color plates (paintings), 27 line drawings and 11 maps. The current book contains more pages, much more text,

more line drawings and 12 even better maps.

The current volume also contains a plus the previous volume did not have: 140 color photographs; there were no photos in the previous book. These pictures are a real treat, showing leaf and flower color variations you'll never see in your local general plant nursery but which are sure to make you want to order some new varieties' seeds or plants forthwith. Locating so many good photos of cyclamen over such a broad spectrum of leaf and flower types and including them in one book amounts to a triumph in itself. While I admire the charm of the paintings and drawings in the older work, I can't deny the dazzling effects produced by the color photos in this version. Truly wonderful beauty is here shown, making one wish for acres to set aside simply for the culture and enjoyment of this diverse genus in which the flowers, often enough, are simply a bonus—admittedly an important bonus—to the incredible beauty of the leaves.

In fact, because the leaf markings and leaf shapes of some species can be so diverse and their flowers so ornamental there are individual species of *Cyclamen* one could concentrate on for a lifetime and therein find great satisfaction, *C. coum, C. hederifolium* and *C. graecum* for instance. Mr. Grey-Wilson pictures many variations within these species and describes even more.

But the so-called florist's cyclamen, *C. persicum* is the queen of the genus. Lovely and graceful in its wild forms, spectacular and bodacious in its numerous cultivated forms this species has accomodated itself wonderfully well to the hybridizer's brush. Mr. Grey-Wilson acknowledges this fact by devoting considerable space to this species and its (mostly intraspecific) hybrids.

Mr. Grey-Wilson recognizes a new species since writing his 1988 book—*Cyclamen colchicum*—raising the total species count from 19 to 20. Also, he recognizes three more interspecific hybrids since his previous cyclamen book raising this count from 4 to 7. (Two additional interspecific hybrids are mentioned but they remain unconfirmed, and therefore, as yet, unnamed.)

While this new book contains at least twice as much information as its ancestor, the type font has been reduced to make room for all that additional information. This may make the book a little hard to read for some people. To compensate partially for that disadvantage the book is printed on a good coated paper stock, another sign of its overall improved quality over its predecessor.

The current volume contains extensive information on cyclamen species, varieties and cultivars as well as sources for seeds and plants, information which no doubt will be met with cheers by growers and hybridizers who need such information or who just enjoy reading about the numerous diverse variations on a theme

which have been wrought over the millenia by Nature and over the last (at least) 17 decades by people. But the hybridizer's brush is not always necessary in order to acquire new cyclamen types. So generous is Nature with leaf and flower variations within this genus that, often, simple observation and selection from among growing batches of wind- or insect-pollinated seedlings or the collection of seeds from new types discovered growing in the wild—and the raising and selection of their seedlings—are sufficient to bring fine new forms into cultivation.

This is a grand book on a Mediterranean genus now grown and loved throughout the world. For those of us who are cyclamen enthusiasts, it's a must-have.

Charles Hardman

DAFFODILS For American Gardens by Brent and Becky Heath. 1995. Elliot & Clark Publishing, Washington, D.C. Hardcover. 7¼ x 9¼ inches.144 pp. 309 color photos. $25.00

This book is not a comprehensive daffodil listing, rather it is an excellent book for gardeners on how to *grow* daffodils successfully.

The introduction includes a history of the daffodil industry in the U.S.A. Then follows daffodil anatomy, 22 pages on culture, including regional advice, naturalizing daffodils, companion plantings of annuals and perennials, forcing flowers out of season, hybridizing, using cut flowers, daffodil shows and exhibitions, sources, societies and a USDA hardiness map. Display gardens in the U.S. that feature daffodils in season are listed.

Twenty-seven pages of daffodil cutivars are included. Basic information such as flower color, fragrance, height and flowering season are included. Each cultivar is shown in a small color photo. The color photos are excellent.

Daffodils can be grown in almost all areas of the U.S. and this book should inspire more people to plant, grow and enjoy these wonderful flowers. The keys to success are all here.

Michael Vassar

TRILLIUMS by Frederick W. Case, Jr. and Roberta B. Case. 1997. Timber Press, Portland OR. 285 pages. 78 color photos. 6 x 9". Hardcover. $29.95

I still remember the first *Trillium* species I ever saw when, as a youngster, I observed colonies of *Trillium ovatum* in the moss-covered forest floor under large Douglas Fir trees in western Oregon.

The showy flowers were not really spectacular but were strangely different from any other flower I had ever seen. Trilliums are like that—odd enough to be remembered.

The Case's have produced a beautiful book, the result of over 45 years of growing, studying and searching out trilliums. Other than the fact that some names will be disputed, changed or added, everything else one needs to know about trilliums is included in this book.

The well written, easy-to-read chapters include an introduction, plant structure, biology, horticulture, conservation, taxonomy, a key to the species and a complete species listing. The keys have useful small drawings to help quickly distinguish one from another.

Each species listing includes the botanical name, synonymy, common names, plant habit, growth season, distribution (including a distribution map), varieties, forms and hybrids along with many other useful comments.

All thirty-eight North American species and five Asian species are covered. The 78 color photographs are superb.

The chapter on horticulture is the best I have seen for any group of plants in a long time. The authors have extensive experience growing and propagating trilliums, plus the additional advantage of knowing and sharing information with other trillium enthusiasts world-wide, thus providing up-to-date information from many parts of the world.

Many of the most beautiful selections of species have been slow to propagate and often expensive when available. Many years ago I saw a bed of a spectacular double white-flowered trillium at a nursery in southern Oregon. The owners had been propagating that clone for many years and still did not have adequate stock to distribute. It is good to read that tissue culture techniques are just starting to show successful results in propagating this genus.

TRILLIUMS should be in the library of every person interested in bulbs and native wildflowers. This relatively small book is a most useful field guide for identification and successful culture of nursery propagated stock. It is well worth the reasonable price.

Michael Vassar

PLANT FAMILIES WITH GEOPHYTIC SPECIES

Last year's list of all the plant families which have species that are tuberous, bulbous, cormous or rhizomatous proved most interesting. I had read that there were about 30 families that would qualify. After a few hours of research I came up with 77 families but have since added more. I thank those who responded with additional families to put on the list. Please let me know if you are aware of other plant families that should be included

Adoxaceae
Agavaceae
Aizoaceae
Alismataceae
Alliaceae
Aloaceae
Alstroemeriaceae
Amaryllidaceae
Anthericaceae
Apiaceae
Apocynaceae
Aponogetonaceae
Aracaceae
Araliaceae
Asclepiadaceae
Asparagaceae
Asphodelaceae
Balsaminaceae
Basellaceae
Begoniaceae
Berberidaceae
Bignoniaceae
Cactaceae
Campanulaceae
Cannaceae
Colchicaceae
Commelinaceae
Compositae (Asteraceae)
Convolvulaceae
Crassulaceae
Cruciferae (Brassicaceae)
Cucurbitaceae
Cymodoceaceae
Cyperaceae
Davalliaceae
Dioscoreaceae
Dracaenaceae
Droseraceae
Ericaceae
Eriospermaceae
Euphorbiaceae
Fumariaceae
Gentianaceae
Geraniaceae
Gesneriaceae
Graminae (Poaceae)
Haemadoraceae
Hippuridaceae
Hydrocharitaceae
Hydrophyllaceae
Hyacinthaceae
Hypoxidaceae
Icacinaceae
Iridaceae
Juncaceae
Lamiaceae
Leguminosae
Liliaceae
Malvaceae
Mesembryanthemaceae
Moringaceae
Nyctaginaceae
Nymphaeaceae
Onagraceae
Orchidaceae
Oxalidaceae
Passifloraceae
Papaveraceae
Pedaliaceae
Periplocaceae
Phytolacaceae
Piperaceae
Poaceae (Graminae)
Polygonaceae
Polypodiaceae
Portulacaceae
Potamogetonaceae
Primulaceae
Ranunculaceae
Saxifragaceae
Scrophulariaceae
Solanaceae
Taccaceae
Tecophilaceae
Trilliaceae
Tropeolaceae
Typhaceae
Umbelliferae
Vitaceae
Zingiberaceae

MGV